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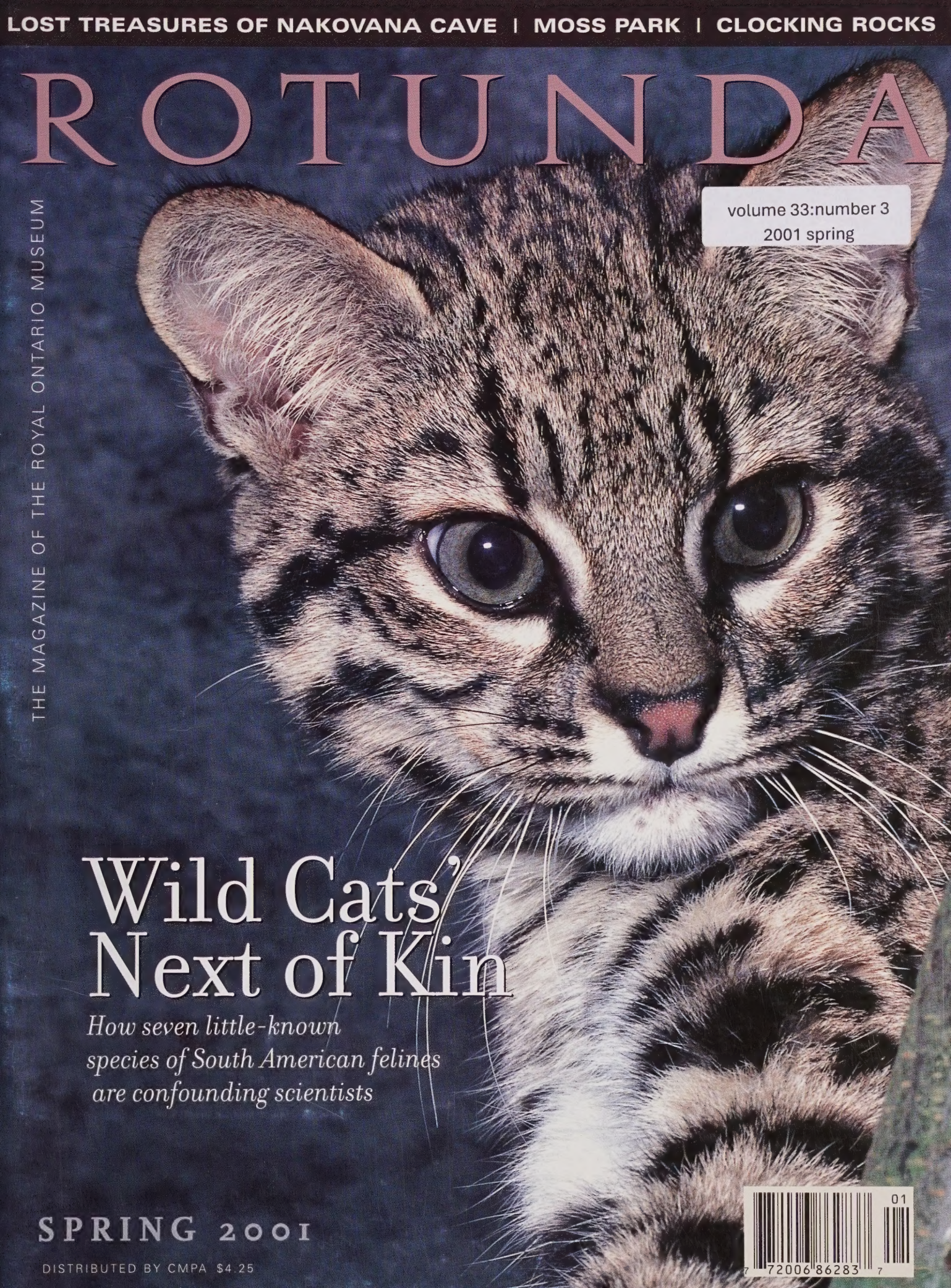
ROTUNDA

THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

volume 33:number 3
2001 spring



Wild Cats' Next of Kin

How seven little-known species of South American felines are confounding scientists

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Pamona by Cameron Douglas. Photo by John Dean

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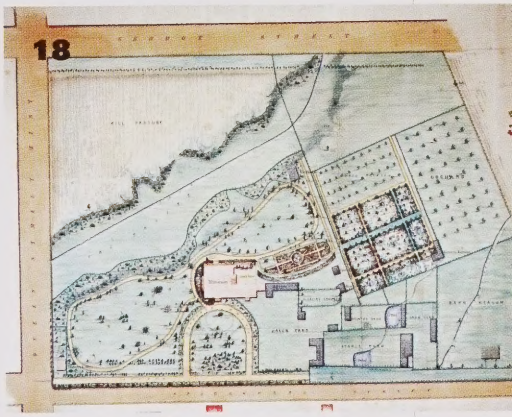
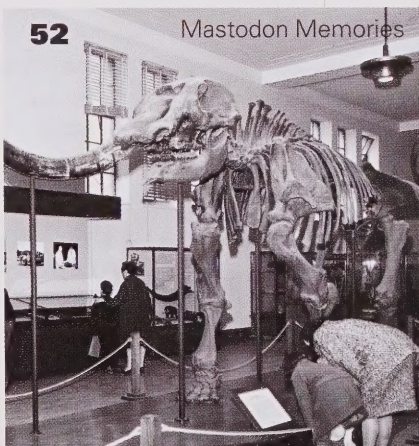


Big house in Toronto's woods



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THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

WILLIAM THORSELL

IT IS A CLICHÉ to describe the ROM as a treasure house of material culture and nature, but that doesn't make it any less true. The fact is that many of the ROM's treasures never see the light of day. It is a revelation to get behind the scenes and spend some time in the vaults with individual curators and the collections in their safekeeping. Any new director must do this, but all the more so when one is coming from another field. The experience is exhilarating and mystifying. How can so many compelling artifacts be stored away from public view and investigation? How can so much be exposed so rarely to so few?

The earliest provocation came through a visit to the ROM's textile and costume vaults, which take the form of large moveable stacks and cupboards on the fifth floor of the Curatorial Centre. Here we find a remarkable collection of humanity's most intimate arts, speaking volumes about values, hopes, and ideals. How proud the French aristocrat must have been in the late 1700s when he first wore that robin's-egg blue embroidered suit of clothes to court. How secure the Chinese mandarin must have felt in 1885, displaying his exquisitely crafted gown in public. And in the 1950s, how beautiful the Toronto hostess in that ebullient black gown by Dior as she swept down the grand staircase to greet her dinner guests in her Rosedale drawing room, where dressing brilliantly was a high social art.

The ROM's intriguing textiles and fashions have not been much on public view in recent years—an anomaly that will be corrected in Spring 2002 with the opening of the Patricia Harris Textile and Costume Gallery, followed by a special exhibition on 1950s haute couture in Weston Hall. In fact, the revival of the ROM's profile in this field will begin next fall through the Institute of Contemporary Culture's exhibit *Papiers à la Mode*, an internationally recognized exhibition of historical fashions constructed entirely from paper.

GIFT OF MRS. M. JAMES BOYLEN. 970.358.7.A

Raising the profile of ROM textiles—like this ball gown of black silk velvet with rhinestones designed by Norman Hartnell in the mid 1950s.

The recent purchase of the Key collection of Canadian minerals provoked another kind of question: Why don't we offer more volume and density from our collections in our public exhibits? It is true that clarity and elegance can be achieved by featuring only a few prize examples of things in displays—and that should rightly occur. But great pleasure and appreciation can also be derived from an avalanche of good specimens, which deepens the visitor's experience of the Museum.

The stunning crystals and aggregations in the Key collection lose nothing by being seen cheek to jowl on an examination table in 3B, in the Curatorial Centre. We should flood the senses sometimes with the sheer volume and diversity of specimens in our possession, from rocks to bats.

The dome of the unused planetarium is now filled to the top with furniture from Canada and Europe, moved in last summer from the Sigmund Samuel building and other parts of the ROM. We aim to bring out much of the Canadian material, in particular, as we reconceive our major galleries. More surprising is the collection of Canadian historical paintings and prints—some 10,000 or so—stored in vaults just under the restaurant Jamie Kennedy at the ROM. They range from vast romantic views of the landscape in the manner of Turner and Constable, to nostalgic images that served as covers for the *Canadian Home Journal*, and 41 works officially known as the National Portrait Gallery (the result of a bequest in 1939). On the other side of the building, we store more than 100 paintings by Paul Kane of aboriginal life in Western Canada and 18,000 artifacts from Canada's aboriginal peoples. Many of the Kane paintings were on show through February in the Hydro One Gallery, but the bulk of our historical paintings and aboriginal holdings are not exhibited.

Intensified use of existing, renovated, and new spaces through our Master Plan will bring a significantly greater proportion of our holdings to public view. Seeing what we've got is, after all, primarily why people come to the Museum. Considerably more of that is on the way.

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THE ROM GRATEFULLY ACKNOWLEDGES THE LOUISE HAWLEY STONE CHARITABLE TRUST FOR ITS GENEROUS SUPPORT OF THIS PUBLICATION

LEE-ANNE JACK

UNEXPECTED CONNECTIONS—whether across disciplines or simply between disparate pieces of history—can make a story shine. When ROM curator emeritus Mary Allodi started writing about two recently donated watercolour paintings of William Allan's mansion, Moss Park, the connections between figures from Toronto's early history quickly emerged. These connections were tangible evidence of just how tightly knit the Family Compact was in Upper Canada during the mid-1800s: almost every one of Allan's compatriots—from his gardener to the man hired to paint the sketches of his home—is remembered in Toronto's street or park names. Allan himself was immortalized by his son, George, who donated land to the city to create Allan Gardens in memory of his father.

Going much further back into Ontario's history, to Precambrian times 550 million to 4000 million years ago, ROM geochronologist Don Davis makes different connections. Using the concept of "deep time," Davis takes the measure of geologic time from Earth's rocks. Ontario is a natural starting point: it hosts the largest section of Precambrian crust in the world.

Don details the story of how he and colleagues in the ROM's world-renowned Jack Satterly Geochronology Lab use precise zircon-dating methods to discover not only the province's major geologic events—the birth of mountain chains, the destruction caused by an enormous meteorite impact—but in what sequence of time they happened. It's a process that gives the story of Earth's history its narrative line.

In another part of the world, in South America, interrelationships between the small wild cat species are still being worked out by science. ROM palaeontologist Kevin Seymour travelled to more than 20 museums around the world looking for clues about these enigmatic cats in the existing skull and skeleton collections. In our cover story, Kevin takes readers along on the journey as he assesses the evidence needed to solve the case. No easy task considering this group of cats is so little known that some have only rarely been spotted in the wild. This made the search for photos a challenge for the editor, too. Some of the most elusive of the cats have been so infrequently photographed that the same pictures turn up in book after book (and again in the pages of this magazine).

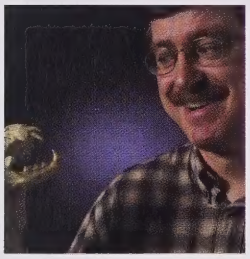
Archaeologists can spend a lifetime looking for that big discovery—a previously unknown civilization or a missing piece of an existing puzzle. Inside a concealed gallery in a remote Dalmation cave, ROM research associate Tim Kaiser made his big find. He has unearthed new evidence of a little-known Bronze-Age Illyrian civilization. In this issue, he chronicles his remarkable discovery of hundreds of pottery fragments dating as far back as 1500 BC and presents new evidence suggesting that an ancient fertility cult was practised in the cave, perhaps for hundreds of thousands of years.

I hope that in reading this issue you make some new discoveries of your own. Enjoy.

Donald W. Davis

Earth Sciences Department

DONALD W. DAVIS (*Deep Time*) earned his Ph.D. at the University of Alberta in 1978. Since then, he has worked in the ROM's Earth Sciences Department and is now managing director of the Jack Satterly Geochronology Lab. Over the past 22 years he has been applying precise geochronology to solving geologic problems in numerous areas, but particularly in Ontario's Superior geologic province.



Kevin Seymour

Department of Palaeobiology

KEVIN SEYMOUR (*Tracing the Feline Line*), an assistant curator in the ROM's Department of Palaeobiology, has recently completed his doctoral thesis on South American small cats, both fossil and living. He also oversees the care of the ROM's vertebrate fossil collection. Besides studying cats, Kevin is currently involved in the study of several Ice Age faunas from Ontario.

Mary Allodi

Department of Western Art and Culture

MARY ALLODI (*Landmark Sketches*) is curator emeritus responsible for the ROM's collection of Canadian paintings, prints, and drawings. Her publications include *Canadian Watercolours and Drawings in the Royal Ontario Museum* and collaborative works *Printmaking in Canada*, *An Engraver's Pilgrimage*, and *Berczy*. In 1999, Mary was named a member of the Order of Canada.

Stephen Otto

Consulting Historian

STEPHEN OTTO (*Landmark Sketches*) is a Toronto-based consulting historian. He is former head of Ontario's heritage conservation programs and has written widely on biographical and architectural subjects. In 1986, he was responsible for revising Eric Arthur's classic, *Toronto: No Mean City*.

Timothy Kaiser

Department of Western Art and Culture

TIMOTHY KAISER (*The Secret Chamber*) is a research associate in the Department of Western Art and Culture. Dr. Kaiser has conducted archaeological fieldwork in the Adriatic and in the central Balkans for the last 20 years.

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ROBERT PATZNER

It's All Relative

Making fishy connections in shallow water

THE ORDER Zeiformes contains about 40 species of primarily deep-water fishes. An exception is the John Dory or St Peter's fish (*Zeus faber*), sometimes found in a few metres of water. Interrelationships of zeiforms have recently been studied by Jim Tyler of the Smithsonian Institution and Bruce O'Toole and Rick Winterbottom of the ROM, using specimens from the ROM and Smithsonian collections as well as those from other museums around the world. Bones of 20 species were examined to form a hypothesis of the interrelationships within the order. This detailed study, the first ever performed on the group, will shortly be published in the *Smithsonian Contributions to Zoology*.

Rick Winterbottom

BRIAN BOYLE, ROM / 2000.48.1, ROM FOUNDATION FUNDS AND THE LOUISE HAWLEY STONE FUND.

Out of the Blue-and-White

A 17th-century potter painted it his way

TWO PAIRS of deer pivot around the centre of this Persian dish, gamboling on a ground of cobalt blue. Their heads face in a single direction, the whirling action accentuated by ever-widening circles painted in black. As the dish is rotated, a verse in the style of the famous Persian poet Omar Khayyam (d. 1123) can be read in Arabic script. The poem refers to God the Creator as a potter, who forms a beautiful object—humankind—then dashes it to pieces. The inscription concludes with the Muslim year 1084, which translates to 1673–1674 AD.

This dish, recently acquired by the ROM, is not only a beautiful display piece; it is one of about only two dozen existing vessels that bear dates from the Safavid period. The dish is also important for its highly unusual design. Most ceramic vessels from this period imitate the Chinese blue-and-white porcelains that were then arriving in Iran in great quantities: in the 17th-century much of the world seems to have been taken with Chinese porcelain. Our potter dared to depart from this practice. This design was painted with black outlines, reserved against the blue. The cuddling deer are more akin to Persian manuscript illustrations or wall paintings than to Chinese ceramic decoration. The ROM's database—which details 60 of our own Safavid artifacts and 1000 pieces from other collections worldwide—revealed two more vessels decorated with similar pairs of deer. These pieces are not dated but they are signed. The artist was Khvajah Muhammad, the only Safavid potter who signed his work. If he is indeed the maker of our dish, by putting these facts together, the ROM has made a significant contribution to the history of later Persian pottery.

Lisa Golombek

BRIAN BOYLE, ROM

Ways of the Bone People

Dental drills, sewing needles, make extractions easier

How to extract fossil bones from the bedrock in which they are found without damaging them is the driving question behind the work of the ROM's vertebrate fossil preparators. The answers are as varied as the fossils being prepared—from a tiny ichthyosaur skull, to a hefty front limb bone of a north African sauropod. There are almost no schools that teach the skill. It is so specialized that most techniques have been handed down—the results of individual innovation or plain old trial and error. A background in the arts helps in visualizing the fossils entombed in rock.

Even the tools of the trade must be fashioned on the job: those designed specifically for fossil preparation are not manufactured. A variety of dental picks, fine carbide rods, and even phonograph needles held in pin vices are useful in working on delicate fossils such as the intact braincase of a small theropod dinosaur *Chirostenotes*, which recently came to our lab. A small foramen was inaccessible with a silicon carbide rod. Instead, I bent a sewing needle into a hook. For other fossils requiring fine, detailed work, such as the cervical vertebrae of an *Eoraptor* specimen, an early dinosaur from Argentina, we have adapted old dental drills, dremmel tools, and electric dental grinders. A small pneumatic airscribe (a mini jackhammer) adapted with carbide bits is used extensively to chisel away rock.

Ian Morrison

BRIAN BOYLE, ROM / 976.289.4

Taming of a Tiger

An education in Chinese puppetry

The art of shadow puppetry, believed to have originated in the early part of the Han dynasty (206 BC–AD 220), has charmed Chinese of all ages for more than 2000 years. Made of paper or leather movable parts attached with bamboo sticks for manipulation, shadow puppets are brightly coloured translucent figures, incised with many slits along their contours to allow extra light to pass through and enhance the details of face and clothing. When the puppets are animated behind a thin, white, backlit sheet, spectators on the other side would see colourful silhouettes acting out popular stories, usually to the accompaniment of music and narration.

Shadow puppet theatre provided great entertainment, but it also offered immense educational value: moral concepts, political ideas, and even satirical comments were effectively conveyed through shadow puppet dramatizations. The ROM owns two identical sets of paper shadow puppets (one of which we know was made in 1936) equipped with bilingual Chinese/English sentence cards, evidence that shadow puppet threatre served a new role in the early 20th century: as a teaching aid for foreigners learning colloquial Mandarin. Entitled *Tiger Story*, these rare examples were made by Yu Zidan of Chengdu and donated to the Museum in 1976 and 1998 by relatives of Dr. Margaret Quentin and Lillian Hinton, both missionaries to China in the 1930s.

Ka Bo Tsang

Gold stag pin adapted from a standing stag, possibly from Inner Mongolia, 5th century B.C.

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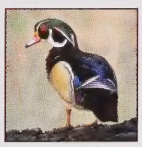

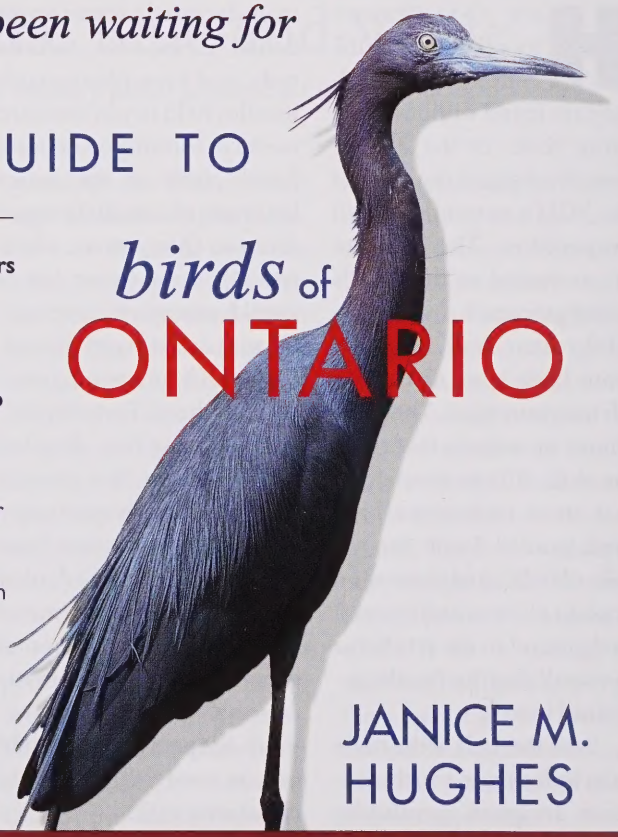

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Much Ado About Masons

IN THE FALL 2000 ISSUE of *Rotunda* I very much enjoyed reading Keith A. Jamieson's article on Oronhyatekha. There is just one point on which I should like to offer a correction, and to enlarge somewhat on the author's remarks. On page 34, we read that "There was . . . a distrust of his [Oronhyatekha's] affiliation with many secret societies, including the Good Templars, a sect of the Masons." The Freemasons are not a secret society. Their meeting places are well known in their communities, and the dates of their meetings are well publicized. And to refer to one of the concordant or appendant bodies of Masonry as "a sect" likewise is misleading, making it sound as if the Masons are a religious order—which is not true.

Oronhyatekha was apparently quite active in the basic Masonic organization, the Lodge of Freemasons. On page 259 in the history of the Grand Lodge, entitled *Whence Come We? Freemasonry in Ontario 1764–1980*, under the heading "Physicians" is this entry: "Dr. Peter Martin, or, to use his Indian name, Oronhyatekha (M, 1841–1907), Government Consulting Physician to the Indians of Canada, and Supreme Chief Ranger of the Independent Order of Foresters, was Master of Richardson, No. 136, Stouffville, in 1894." (The letter "M" before his dates indicates that his name occurs in the *Macmillan Dictionary of Canadian Biography*, 4th edition, Toronto, 1978.)

If one consults the older published documents of the Masonic Grand Lodge, these details are confirmed. In the published proceedings of the 52nd annual communication of the Grand Lodge of Canada held in Ottawa in July 1907 is a list of deaths. There, on page 380, under Lodge No. 136, is the entry "Peter Oronhyatekha, 2 March '07." These entries suggest that he was in fact active in his lodge. I do not have any information as to the concordant Masonic bodies to which he may have belonged.

COURTESY THE WOODLAND CULTURAL CENTRE MUSEUM

Oronhyatekha

Just a small point, but it seemed worth writing to you about it. Keep up the good work.

WALLACE MCLEOD
PROFESSOR EMERITUS OF CLASSICS
UNIVERSITY OF TORONTO

P.S. As an addendum to my earlier letter, I recently came across a paper entitled "Dr. Peter Martin, M.D. (Oronhyatekha)," by Clifford E. Rich, originally presented to the Canadian Masonic Research Association in March 1973. I had naively assumed that the Good Templars was another name for the Masonic Knights Templar, which is an appendant order of the Freemasons. But I now find that I was wrong in this assumption, and that Mr. Jamieson was incorrect in his statement. On page 1878 of Clifford Rich's article, he says of Oronhyatekha: "While still at school he had joined the "Good Templars" — a Temperance Association. He was always a fighter against alcohol. Later in life, at a World Gathering of the Good Templars held in Edinburgh, he was elected as Grand Templar and Head of "The International Good Templars of the World." At that time the Order had a worldwide membership of about 600,000 and was probably the strongest foe of the liquor traffic."

On page 1879 Mr. Rich adds that in 1892 Oronhyatekha was elected in Edinburgh as Right Worthy Good Templar of the World; the event was reported in the *Toronto Daily Mail*, April 22, 1893.

I could enlarge on Oronhyatekha's Masonic activities, about which Mr. Rich tells us a good deal, and about which (it turns out) Mr. Jamieson tells us nothing. But I refrain. Once again, keep up the good work.

Response from Keith Jamieson: One of the most appealing aspects of the Dr. Oronhyatekha story is the seemingly endless number of windows on the world that open in the retracing of his steps.

As Professor McLeod so aptly points out in his letters, it is all too easy to make assumptions about relationships within the myriad of networks and affiliations cultivated by Dr. Oronhyatekha. It has been a daunting task to attempt to clarify them, and I do appreciate it when interested parties contribute their expertise. It is through articles such as this, and through the response from readers that the life and times of Dr. Oronhyatekha continues to challenge us in its breadth and depth. Thanks to Professor McLeod, we can now add another to the lengthy list of Oronhyatekha's titles, that of "Right Worthy Good Templar of the World."

As a postscript to the article, both Mrs. Eva Maracle and Mrs. Ella Claus have since passed away. I wish to express my appreciation for their in-

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We are here to answer your questions.

valuable contribution to this project, as their participation underscores the essential role that collective memory plays in the life of our communities.

I'd also like to mention that Dr. Oronhyatekha is currently being considered as a national historic figure by Heritage Canada.

The Bear Facts

I READ WITH GREAT INTEREST the article "43rd Parallels" (Winter 2000) by Gary Crawford. While I agree with the major conclusions, I respectfully but strongly disagree with statements concerning the *Iyomante*, the sacred Ainu bear ceremony. First, Dr. Crawford refers to the importance of *Iyomante* in the past tense, as if it were no longer important, or perhaps no longer celebrated. I state unequivocally that we Ainu strongly believe in the bear ceremony, and I assure readers that the ceremony continues!

Secondly, Dr. Crawford states that the bear is "sacrificed to release its spirit." I cannot state strongly enough that the ceremony is not a sacrifice, and the use of the word gives the wrong impression. We believe the bear is the God of the mountain, and comes to Ainu land (human land) in a physical sense from Gods' world to share its meat and fur with the Ainu people.

The bear God knows before coming to the Ainu that it must be slain in order for its spirit to return to Gods' land to inform the other Gods of its treatment. In the sacred sense, a sacrifice is usually made to God; in this case the bear is God. It is the bear's duty and privilege to report on the Ainu—there are no sacrifices.

Lastly, Dr. Crawford is only partially correct about the *heper-ay*, or ceremonial arrows used in the bear ceremonies. The arrow is of a two-piece construction, and [Ainu elder] Shigeru Kayano and others are very clear that the shaft can be made from linden, willow, or wormwood. However, the all-important arrowhead, which slips into the shaft, is always made from hydrangea. The head is "painted" black with soot from burnt birch bark, and becomes the "canvas" on which the *Iyomante* host and others can carve their family and/or regional design. The ceremonial arrow is not meant to harm the bear; in fact, most arrows bounce off the bear's fur. Their purpose is to excite the bear's spirit as it prepares for its journey home.

Both the tenets and nuance of the Ainu spiritual belief system are very complicated, and unfortunately, the consequence is a great deal of unintentional misinformation.

CHISATO (KITTY) DUBREUIL
VICTORIA, B.C.

Response from Gary Crawford: Chisato Dubreuil's clarification of my comments on the bear ceremony are welcomed. In an attempt to be brief, my choice of words may not have been the best. Ainu people are justifiably concerned about interpretations of the bear ceremony. It was outlawed by the Japanese government around 1800. This was a significant interference in Ainu life, one partially based on the impression that the bear is cruelly "sacrificed" rather than killed according to carefully proscribed rules as outlined by Ms. Dubreuil. One anthropologist, Emiko Ohnuki-Tierney, characterizes the ceremony's relevance to the Ainu as the "most important form of gift exchange, and it occurs at the cosmic scale . . ."

The *Iyomante* has an additional effect among many Ainu: social solidarity. As part of an official assimilation process, it would have been important for the Japanese government of the early 19th century to put an end to the rite. But in recent years, Ainu culture has been undergoing a revitalization process, including the revival of such ceremonies as the *Iyomante*.

If readers wish to learn more about the ceremony or other aspects of Ainu life and history, I recommend two recent books, *Ainu: Spirit of a Northern People*, edited by William Fitzhugh and Chisato Dubreuil (Smithsonian Institution) and *The Return of the Ainu* by Katarina Sjoberg (Barwood Academic Publishers).

CULTURE, ART AND DESIGN

Many Splendid Things

A gift of unprecedented generosity from Joey and Toby Tanenbaum takes the ROM's already internationally renowned Chinese and Near Eastern collections to new heights.

ARIADNE GALLERIES, INC.

On November 2, 2000, the ROM announced the largest gift ever received in its 87-year history: 1800 works of art and archaeological objects, half from China and half from the Near East and southern Europe, donated by Joey and Toby Tanenbaum. Except for a set of 19th-century photographs from China, all the objects range in date from about 4000 BC to 1600 AD. With a collection of such magnitude, it will take

KLAAS RUITENBEEK

considerable time and careful study to assign each artifact to its appropriate place in the existing Museum col-

Top Left: This Chinese tile with double-headed bird, 6th century AD, is of glazed, partially painted earthenware. Height: 33 cm. Top right: This earthenware mould for making clay figures from early 2nd millennium BC is classically Syrian in form. Height: 19 cm. Bottom right: This painted earthernware horse was made in China in the 7th century AD specifically for use as a tomb figure. Height: 75 cm.

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lections. But the public will not have to wait until then to enjoy this magnificent gift. A large selection of objects will be on display in a special exhibition, *Just Uncrated: Masterpieces from the Tanenbaum Gift,* from April 21 to September 3, 2001.

The Near Eastern and European part of the collection, consisting mainly of small objects of archaeological interest, contains about 850 items made of bronze, ceramic, stone, and other materials. Dating from about 4000 BC to the beginning of our era, their provenances are quite diverse: there are large groups from Mesopotamia, Turkey, and the Balkans, and objects from Spain, France, Cyprus, the Cyclades, Egypt, Syria, and Afghanistan.

Particularly interesting is a ceramic mould from Syria for producing clay figures, which dates from the early 2nd millennium BC. It realistically portrays a female figure, shown in a manner typical of Syrian art: it has a protruding nose, defined breasts, folded arms, and long straight legs. The mould is unusually detailed in the depiction of hair, knees, and necklaces.

The Chinese artifacts are the most visually spectacular of the gift. Many are large and of considerable artistic significance. There are some 60 stone and ceramic objects from the Neolithic Period (4000–2000 BC), 600 bronze objects dating from the 12th century BC to the 8th century AD (including 500 arrowheads), almost 200 ceramic objects from 500 BC to 1600 AD (of which 115 are tomb figures), and 17 Buddhist stone sculptures from the 5th to 8th century AD.

Except for the Buddhist sculptures, all the Chinese material is from tombs. The bronze objects—bells, vessels, weapons, mirrors—are identical to ones used in daily life. But the ceramic tomb figures were made specially for burial and had no other function. It is rare to to find such figures in good condition because many of them, especially earlier ones, were unglazed and the paint therefore easily flakes off. The ROM already possessed a very large number of tomb figures, but they retain little of their original splendour. The Han Dynasty (206 BC–220 AD) figures from the Tanenbaum gift have added a new dimension to the ROM collection because their original bright painted colours are miraculously well preserved. The Tanenbaums have also given us a large group of delicately painted but unglazed Tang Dynasty (618–906AD) horses and camels, a wonderful complement to the ROM's existing famous collection of glazed examples.

Some of the objects in the gift are mysteries that await the detection skills of researchers. Whether the 15 6th-century green-glazed square relief tiles in the gift once decorated a tomb or another type of building is yet to be discovered. But the rare and fantastic imagery on these tiles depicts mythological creatures that were not previously known.

Of the many fine Chinese bronzes, the bells are perhaps the most imposing objects. There are two bells of 44 cm (17 inches) and 71 cm (27 ½ inches) in height, and a large chime of 10 bells, ranging in size from 28 to 59 cm (11 to 23 inches) and spanning a full octave. All beautifully decorated, they date from the 7th to the 5th century BC and represent the only two types of bell—*yongzhong* and *bo*—that the ROM did not have. Together with the three types we did own—*niuzhong*, *nao*, and *ling*—they give us an excellent idea of early Chinese music.

Even the few objects that could be mentioned in this brief article demonstrate that the Tanenbaum gift is of paramount importance. To the ROM's internationally renowned collection of Chinese art, it has added a large group of objects of a quality rarely found. And it has enriched the ROM's Near Eastern archaeological collections with many beautiful and fascinating specimens.

Klaas Ruitenbeek holds the Louise Hawley Stone Chair of Far Eastern Art. With files from Laura Wood.

LIFE ON EARTH

Owl Prowl

Do these twilight hunters live up to their reputation for wisdom...or deserve their rap as evil monsters? Tracking a few for yourself may give you the answer.

Great horned owl

MARK PECK, ROM

MARK PECK

They are all around us—in the parks, fields, ravines, and woodlots of suburban and rural Ontario. Rarely seen, they are most active during the crepuscular hours of sunrise and sunset. With their furtive comings and goings and their sometimes unnerving vocalizations, owls may be the original inspiration for scary tales of witches, ghosts, and spine-tingling screams heard in the night.

Perhaps in keeping with these terrifying connotations, in the recent past these members of the *Strigiformes* were considered vermin and accused of killing game birds and livestock. In Canada, the United States, and across Europe, owls were heavily persecuted. They were not protected by the *Migratory Bird Convention Act*, and it was legal to shoot, poison, or otherwise kill them. Though today owls are physically safeguarded by law, they remain victims of human ignorance and superstition.

Considered harbingers of death in Eastern cultures and icons of intelligence in the West, these birds of prey are neither—unless, of course, you're a mouse. Visiting the ROM's galleries and collections it is easy to find evidence of people's fascination with owls throughout history. In ancient Egypt, the owl is found on hieroglyphs representing the letter *M*. In Greek mythology, Athena is the owl-eyed virgin goddess of wisdom, reason, and just war. Symbolizing Athena's great knowledge, the owl became a mascot of the Hellenic Greeks and often accompanied them into battle. The Romans, on the other hand, vilified the bird, claiming it to be a foul-smelling monster capable of eating babies.

In Asian cultures, from ancient times to the present, owl parts and owl eggs have been used as cures for headaches, bee stings, snake bites, insomnia, even loss of libidinous desire. In the West, owls often are anthropomorphized as solemn, wise creatures such as the ones that appear in *Bambi*, Winnie-the-Pooh stories, and the books of Beatrix Potter.

In reality, owls are superbly adapted nocturnal hunters. They have excellent vision, acute hearing, cryptic colouration, and exceptionally fluffy plumage that allows them almost silent flight. Their eyes are so large they are essentially fixed in their

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sockets. To compensate, owls have evolved a highly flexible neck that can be rotated quickly and accurately up to 270 degrees. In many species, ear openings are positioned asymmetrically to provide better depth perception, allowing the birds to accurately locate and catch prey under several feet of snow or in almost total darkness. Their diet consists mostly of small mammals but also includes other birds, insects, rabbits, squirrels, skunks, porcupines, and the occasional domestic cat.

There are 164 species of owl worldwide, 12 of which have been recorded in Ontario. On a crisp February day it is possible to find as many as 8 to 10 species within an hour's drive of the ROM. The birds range in size from the 69-cm (27-inch) great gray owl to the small 20-cm (8-inch) northern saw-whet owl, and the similar-looking but slightly larger 25-cm (10-inch) boreal owl. All three species breed in the boreal forests to the north of Toronto but either migrate in autumn or move southward during harsh winters. A quick check of birdwatching sites will tell you which birds have been spotted where. Two you might try are http://web-nat.com/bic/ and http://birdingonthe.net/birdmail.html.

Three of the more common owls—the great horned owl, barred owl, and the eastern screech owl—are year-round residents of woodlots and ravines throughout southern Ontario. In late winter, their hoots, screeches, whistles, and tremulous cries may be heard throughout the night as the birds establish their territories and attempt to attract mates. Long-eared owls and short-eared owls, named for the tufts of feathers that resemble ears on the tops of their heads, also have a wide range of haunting vocalizations, including calls that sound remarkably like the yapping of a small dog.

The barn owl—found throughout many parts of the world but restricted in Ontario to the extreme southern edge—may be the original ghost. In the evening, its ghostly white form may be seen flying low over fields and cemeteries emitting terrifying shrieks and metallic-sounding rattles as it searches for prey. The other white owl seen in Ontario is the snowy owl. This large species, which inhabits arctic Canada during the breeding season but often moves south in winter, may be seen perching on the tops of telephone poles or fence posts in farmland or along lakeshores.

Some of the best ways to prowl for owls are listening for their calls or looking for an avian mob scene. The predatory nature of owls causes great agitation among other bird species. Chickadees and other songbirds are often seen mobbing screech owls or saw-whets in the hope of chasing them away. A murder—or group—of crows calling loudly and flying back and forth around a particular tree usually indicates the nearby presence of a great horned owl.

Another search method is simply to take a walk in the woods. If your neck is limber enough, you can spend a couple of hours looking up into the branches. If you are not so inclined, looking on the ground can prove to be just as effective. While strolling through coniferous or mixed forest, keep an eye out for grey cylindrical pellets at the base of trees. Owls usually swallow small mammals whole. Once the stomach has absorbed the nutritional components, the bird regurgitates the small pellet of fur and bones that remains.

During the winter months, owls often use the same roost trees day after day. Find a pellet and the bird can often be located directly above, sitting quietly on a branch or peering out from a cavity.

Because of their often silent nature and nocturnal habits, owls may seem more rare than they really are. The next time you take a walk in the woods, look and listen carefully. You may be surprised to find an owl living in your neighbourhood.

Mark Peck is a technician in the Ornithology section of the ROM's Centre for Biodiversity and Conservation Biology.

CULTURE, ART AND DESIGN

TIFFANY, TINTAGEL, TOURTIÈRE

Wine and Coins in Ancient Greece

By Peter Franke, Irini Marathaki
(The Hatzimichalis Estate,
Cloth: $149.95)

"We have seen the holy maenads, the women who ran barefoot and crazy from the city."

"Their hair afire with the god's light, they drew honey from the ground."

"Welcome Dionysos to Thebes, and accept his release from suffering, for in his worship are the passions within us all."
—Euripides, *The Bacchae*

MORE THAN A FEW years ago, as a freshman at the University of Toronto, I found myself not only *in* a production of *The Bacchae*, Euripides' tragically bacchic paean to wine, women, and song, but cast as the wine god himself. The play examines the "strange new mysteries" that have befallen the once-staid Thebes as even sage Teiresias, the venerable and blind seer, goes dancing, dismissing his critics with a curt "They are all blind; only we can see." The ROM's forthcoming *Gift of the Gods* exhibition explores the *"in vino veritas"* god from his Greek origins as Dionysos to his Roman incarnation as Bacchus, as expressed through artifacts from the

FEATURE REVIEW

Art Nouveau, 1890–1914

By Paul Greenhalgh, ed.
(V&A Publications, Cloth: $115)

BRIAN BOYLE, ROM

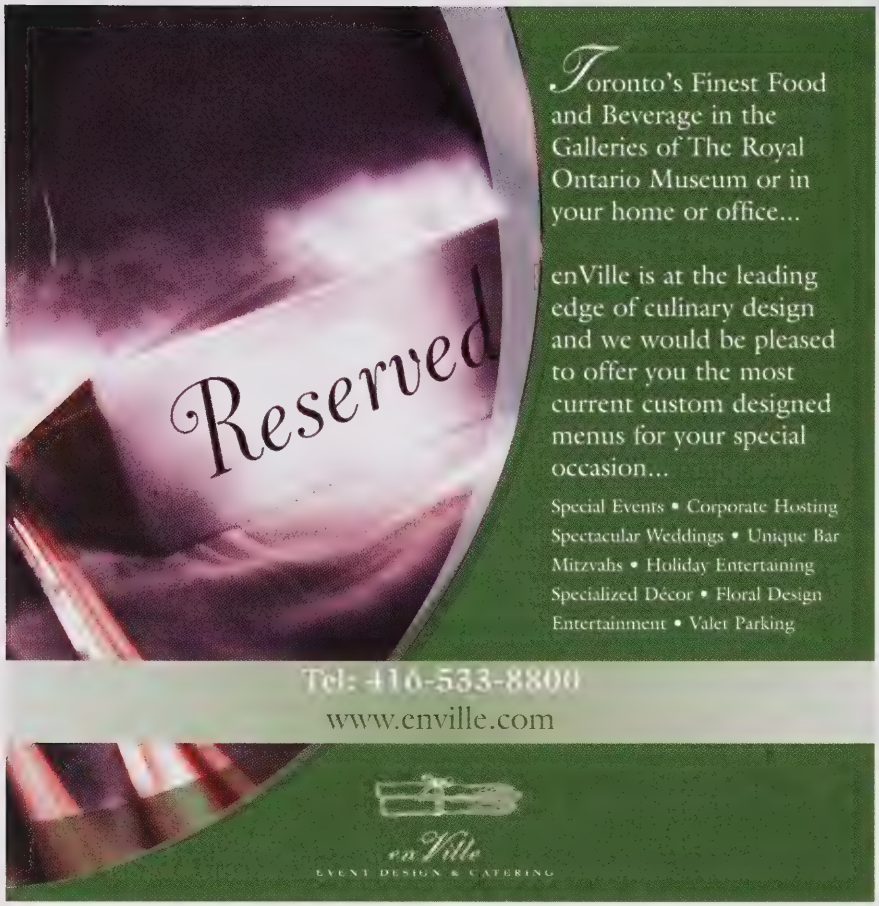
ONE OF THE Art Nouveau highlights of the Royal Ontario Museum is the golden vase (earthenware and lustre glaze), created by Clément Massier (1845–1917), possibly for the 1899 Paris *Exposition Universelle*. One of the many treasures made available through the munificence of ROM patron, donor, and friend Louise Hawley Stone, it is featured in *Louise Hawley Stone: A Life and Legacy* (ROM, 1999), the limited-edition first volume in the ROM's Museum Builders library.

A century ago, when Art Nouveau was at its zenith, London's Victoria and Albert Museum purchased a body of the then-controversial art from the Paris *Exposition Universelle* of 1900. *Art Nouveau, 1890–1914* exhibits many of the treasures of that collection and numerous others. In the words of the V&A's director, Alan Borg, the new art was "a deliberate attempt to transform the visual culture of the urban industrial world." A number of Art Nouveau designers were inspired by the museum's collections and its publications on the principles of ornament as they sought a new artistic path out of industrialization's transmogrification of nature. Through a variety of media—glass, ceramics, furniture, metalwork, sculpture, print, and textiles—artists and designers created a multifaceted, often spectacular decorative art, from Tiffany lampshades to Mucha posters to Lalique jewellery.

A 500-page coffee-table tour de force, *Art Nouveau, 1890–1914* is a photographic jewel, a kaleidoscope of glittering imagery. The large format works well, allowing individual masterpieces to be spotlighted in intricate detail, e.g., René Lalique's *Dragonfly Woman* corsage ornament in gold, enamel, chrysoprase, moonstones, and diamonds, c. 1897–1898, and Lluís Domènech I Montaner's grand auditorium of Palau de la Música Catalana, in Barcelona, 1905–1908.

The publishers have marshalled an array of scholars who illuminate a complex art and analyze the careers of such Art Nouveau luminaries as Aubrey Beardsley, Emile Gallé, Antoni Gaudí, Josef Hoffmann, Victor Horta, Charles Rennie Mackintosh, Louis Sullivan, Louis Comfort Tiffany, and Henry van de Velde. As an added bonus, the bibliography, object notes, and index are superlative. A virtuoso performance, an authoritative and beautiful work.

COMPILED AND REVIEWED BY GLEN ELLIS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In this thematically similar work, Franke and Marathaki explore the topic numismatically. The book's square-format design features full-page enlargements of the coins, to the magnitude of saucers, even bread-and-butter plates. Printed in metallic silver and metallic gold inks, the coins—more precisely the figures on the coins—begin to look like rough-hewn sculptures, including numerous renderings of Dionysos and his retinue of maenads (in their dual identities as high priestesses and out-of-control groupies), silenos and nymphs, Pan, goats and griffins, the warrior Ajax, grapes,vines, kraters, and amphorae. Considering the scale at which these micro-sculptures were carved, the degree of detail is remarkable.

Franke's illuminative essays provide historical and cultural context as he chronicles the subject from the annual Dionysos festival at Elis onward. Marathaki exhibits the coins in the book's catalogue raisonné.

The Encyclopedia of Mythology: Classical, Celtic, Norse

By Arthur Cotterell
(Lorenz Books, Cloth: $31.95)

As a genre in itself, the encyclopedia of mythology is well represented by a proliferation of titles released over the past two decades. This is one of the best, much of its appeal owing to its superabundance of striking images. The art is diverse—from medieval wood carvings to Rackham, to Beardsley, to the contemporary illustrative art of Alan Lee. In one of Lee's paintings, Gwydion, a sorcerer in the ancient Welsh kingdom of Gwynedd, conjures the fairest woman in the world—from the blossoms of oak, broom, and meadowsweet. In another, the blacksmith Sindri, in his cavern forge, fashions Odin's fabulous ring (which dripped eight similar rings every ninth night, consolidating his rule of the nine realms).

Cotterell has written widely in this field. His readers look forward to subsequent volumes of the encyclopedia.

Jamie Kennedy's Seasons

By Jamie Kennedy
Colour photography by Michael Mahovlich
(Whitecap Books, Paper: $29.95)

FRESH OFF GARNERING accolades for his culinary triumphs at Toronto's Scaramouche and Palmerston, master chef Jamie Kennedy was quick to achieve new levels of praise with his launch of (and perennial success at) Jamie Kennedy at the ROM, his restaurant at the top of Canada's international museum. A leader of the national cuisine, Kennedy works within the framework of Ontario's seasons and the availability of ingredients on a seasonal basis. And so, beyond his "basics," such as tomato consommé, marinated salmon, and crêpes, his recipes are grouped by season. Kennedy also advocates home preserves—capturing summer for another season—and organic produce. With friend and colleague Michael Stadtlander, he founded an alliance of organic growers and chefs. Kennedy also recognizes and celebrates the culinary diversity of Toronto as a cosmopolitan metropolis, always seeking out exotic ingredients in the city's specialty food markets.

The book is well written and well designed; the photography is superb. It's as if Kennedy is there with the home cook, guiding every step. He even imparts the fine points of peeling chestnuts, gleaned from a local vendor.

The delectables include *Roasted Chicken Breast with Succotash and Light Sage Sauce*, *Dover Sole Paupiettes in Provençal Bouillon*, and *Maple Walnut Ice Cream in Maple Crisp with Riesling Poached Pear*. The glossary is a storehouse of gastronomic *mots précis*. Try tossing around *brunoise*, *chiffonnade*, *concassé*, *confit*, *fumet*, *mirepoix*, and *sabayon* the next time you make dinner for someone.

Chef's hats off to a culinary genius. If you buy only one cookbook this year, make it *Jamie Kennedy's Seasons*.

Glen Ellis is head of Publications, Royal Ontario Museum.

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ROM 995.35.2 GIFT OF G. PATRICK H. VERNON

Two drawings preserve the like Toronto's wealthiest and most infl a sizeable portion of what

William Allan commissioned watercolour sketches of his mansion, Moss Park. Both views were painted by John G. Howard in 1834: above is *Moss Park from the South–west* and at right *Moss Park from the South-east.*

THE HONOURABLE William Allan's Toronto mansion—Moss Park—dwarfed its nearest neighbour to the west: Hazelburn, the home of lawyer and office-holder Samuel Peters Jarvis and his wife, Mary. In 1828, just before Moss Park was completed, Mrs. Jarvis wrote to her father, Chief Justice William Dummer Powell, complaining about the size of her neighbour's dwelling and its 12 windows that looked down on her house.

This was a mansion that would have overshadowed any home. Classical in style, Moss Park had four engaged columns across its south-facing front. Its two lofty storeys and basement contained more than 990 square metres (11,000 square feet) on a 40-hectare (100-acre) property extending from Queen Street north to Bloor Street and from Sherbourne Street on the east to George Street on the west. In 1834, Queen Street was considered the far northern edge of the newly incorporated City of Toronto. To the north, the property stretched away into wooded hills.

Five years after Moss Park was completed, its proud owner—one of Toronto's wealthiest and most influential citizens—took the initiative, unusual in Toronto at the time, of commissioning watercolour sketches of it. Since the house was demolished in 1904, the surviving images have become key historical documents that de-

Sketches

ROM 995.35.1 GIFT OF G. PATRICK H. VERNON

ness of the 1830s home of one of uential citizens. His estate occupied is now downtown Toronto.

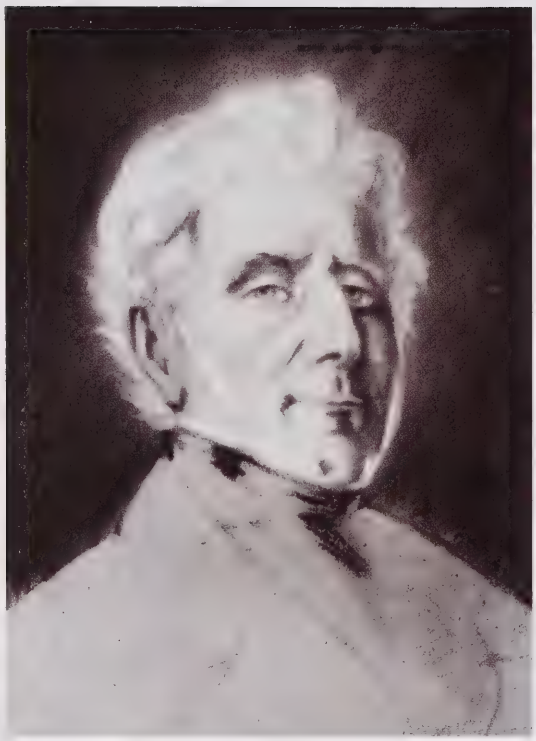
By Mary Allodi and Stephen A. Otto

pict the original appearance of what was once a Toronto landmark and capture an interesting chapter in the city's history. Recently, one of Allan's descendants, G. Patrick H. Vernon, donated the two watercolours to the Royal Ontario Museum.

Rendered by John G. Howard, the views, drawn in pen and ink and watercolour on good quality Whatman paper, survived without harm through the years under a layer of varnish—once considered a protective substitute for glass. Before giving the pictures to the ROM, the donor had them restored, and the age-yellowed varnish was removed.

Born in Scotland in 1770, William Allan emigrated to Upper Canada about 1787, where he was first employed as a clerk for an importing business in Niagara. In 1795, he moved to the three-year-old town of York (as Toronto was then called), acquired a waterfront property, and opened for business as a general merchant. Respected for his financial expertise, Allan was an influential figure in establishing the Bank of Upper Canada, and in 1822 became its first president. He held many local offices and in 1825 was appointed to Upper Canada's Legislative Council and later to the Executive Council.

One of Allan's early homes in York was a two-storey frame house built for him in 1802 by Archibald Thomson, a master car-



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COURTESY CITY OF TORONTO, CULTURE DIVISION

From left to right: William Allan, shown in this pastel drawing c.1845, was a powerful banker and politician; John George Howard painted the watercolours of Moss Park and was himself captured in watercolour in this image by T. H. Stevenson in 1848; the extensive Moss Park domain is shown in this 1854 plan by J. O. Browne, surveyor; photograph of Allan's son George WIlliam Allan c.1860.

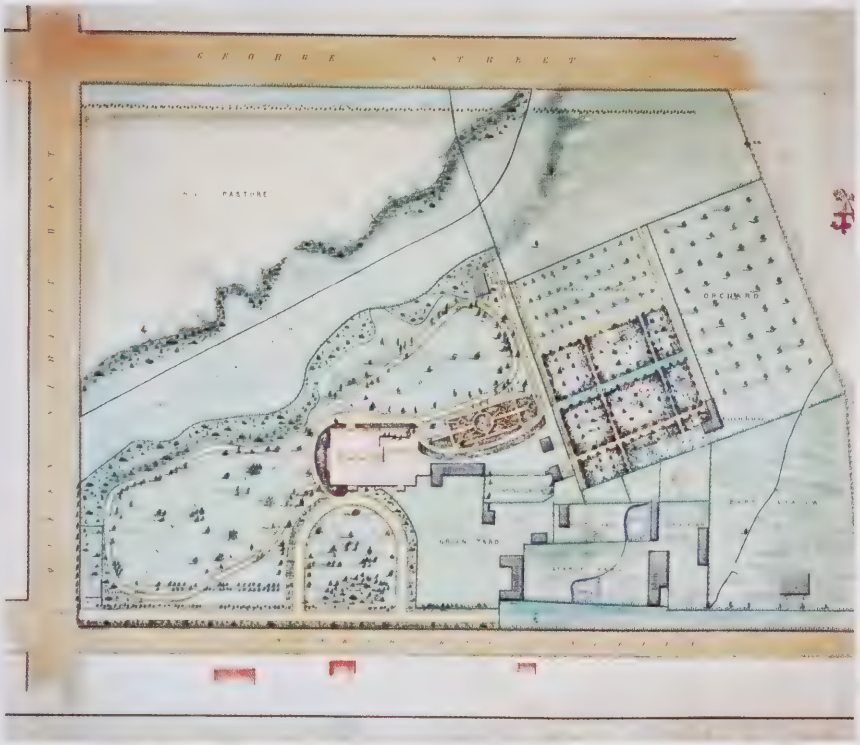
penter and, incidentally, the great-great-great grandfather of newspaper and communications magnate Kenneth Thomson. As Allan's business interests expanded, so did his opportunities as a patron of builders and architects. In 1825, as president of the Bank of Upper Canada, he took a leading role in commissioning designs by Dr. William Warren Baldwin for a new banking house at Adelaide and George streets.

Baldwin, a lawyer as well as a doctor, and father of reform politician Robert Baldwin, would likely have collaborated with John Ewart for practical aspects of the bank's design. Ewart was the city's principal builder during the 1820s and on occasion turned his hand to architecture. It was probably Ewart, a Scot like Allan, who was responsible for designing and constructing Allan's last and most luxurious home, Moss Park.

Construction of Moss Park started in the spring of 1827. Allan had purchased the property—one of 32 park lots that lined the north side of Queen Street—in 1819, naming it after his birthplace in northeastern Scotland. Moss Park's principal elevation looked south to Queen Street, then called Lot Street. The main entrance, however, was on the east side facing Sherbourne, originally known as Allan's Lane. At the southwest, the boundary was marked by a broad ravine and stream that until the mid-1840s caused Queen Street to jog to the south along what is now Britain Street.

By early 1829, construction had progressed to the point where Allan, his wife, Leah Tyrer Gamble, and their children could move into their new brick home. A set of early floor plans describes the impressive layout. The basement housed a wine cellar, vegetable cellars, ice storage, even a boot-cleaning closet. Three large formal rooms dominated the ground floor: drawing room, dining room (each with an area of about 45 square metres or 500 square feet), and a spacious breakfast parlour-cum-library. There was also a bedroom suite with a dressing room—and an indoor water closet, a considerable luxury at the time. An attached wing housed the kitchen, dairy, and wash house.

The upper floor held bedrooms and



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nurseries, the latter serving as a painful reminder that 9 of Allan's 11 children died before the age of 20, many of them from tuberculosis, which also claimed his wife. At Allan's death in 1853, he was survived by only one son, George William Allan (pictured above, right).

Soon after moving into Moss Park, Allan, who had a keen amateur interest in horticulture, commissioned a plan to landscape the estate. He chose André Parmentier, a Belgian-born nurseryman who emi-

Allan the Younger

George William Allan, William Allan's only child to survive him, was born in 1822. Young George followed his father's footsteps into prominence in many aspects of Toronto's affairs. He was an alderman, and in 1855 at the age of 33 served as mayor. Appointed a senator in 1867, George was Speaker of the Senate from 1888 to 1891.

In 1847, he had a house built on the northern half of the Allan family lot, and called it Homewood; but after his father's death in 1853, he moved back to Moss Park. A patron of the arts, George hung the walls of Moss Park with paintings by his *protégé*, Paul Kane. These works, which provide a key record of mid-19th-century aboriginal life in western Canada, now also reside in the ROM's collections.

In 1857, George gave five acres of Homewood's grounds to the Toronto Horticultural Society, and the area (added to by city purchases) is known today as Allan Gardens.

Homewood was purchased in 1911 by Dr. Herbert A. Bruce, founder of the Wellesley Hospital and Lieutenant Governor of Ontario from 1932 to 1937. Unable to secure enough beds for his growing private practice in the existing Toronto hospitals, Bruce started his own. The name Homewood is remembered in a city street in the vicinity.

BRIAN BOYLE, ROM

COURTESY TORONTO REFERENCE LIBRARY

Above: This 1842 pen-and-ink sketch of Moss Park, attributed to James Hamilton, shows an entry portico added to the east facade. Inset: Moss Park today, shown from the corner of Sherbourne and Shuter streets. Right: Photograph of Moss Park from the southeast in the 1880s. The house was demolished in 1904.

grated to the United States in 1824 and is generally credited with being the first landscape architect in North America. Ornamental trees, some perhaps from Parmentier's nursery in Brooklyn, were imported to flank the house and border the serpentine carriageways of the parterre. These can be seen in Howard's sketches, made the same year that Allan and his gardener, George Leslie (for whom Leslie Street was later named), won the Toronto Horticultural Society's first prize for ornamental grounds.

In 1833, with the house completed and the landscape coming along nicely, Allan commissioned John Howard, an Englishman trained as an architect, surveyor, and civil engineer, to sketch his home and its property. Howard had emigrated to Canada in September of the previous year, settling in Toronto. His architectural skills had quickly attracted the patronage of a wide group of clients and the attention of the Lieutenant-Governor, Sir John Colborne, who ensured Howard's part-time appointment as geometrical drawing master at Upper Canada College. When the Society of Artists and Amateurs of Toronto mounted the city's first show of paintings in 1834, Howard was among the organizers and exhibitors. At the end of his life, he deeded his own property, High Park, and his house, Colborne Lodge, to the city.

According to Howard's journals, which survive today, he made preliminary sketches of Moss Park on the last day of December 1833. Between then and March 22, 1834, when he delivered the finished views to Allan, his journal records his working on the sketches on 27 different occasions. The time spent was due perhaps to the fact that Howard was not as comfortable with landscape drawing as with architectural elevations. Recognizing his own lack of skill, Howard had taken a lesson in landscape drawing in August 1833 from John Sanders, an artist then employed as a drawing master at Upper Canada College. Never at ease with landscapes, Howard employed fellow amateur James Hamilton in 1835 to add a garden setting to a presentation design for a college building. Coincidentally, the only

other known early sketch of Moss Park, now in the Toronto Reference Library, is an outline drawing made by Hamilton in 1842 showing the entry portico that was added that year.

Howard's invoice to Allan for £10 describes his drawings as "two Camera Lucida Sketches—1834—of Moss Park and House, mounting, burnishing and framing." For greater accuracy, Howard sketched with the aid of a *camera lucida*, a device with a prism that projects an image onto a drawing surface, which the artist traces. The finished versions, two viewpoints showing different facades of the house, were elaborated from the on-the-spot tracings. They were drawn in pen and ink, then watercoloured, varnished ("burnished"), backed with linen, and mounted on stretchers for framing.

In spite of Howard's hesitations as a landscape painter, his watercolours of the Moss Park estate are expressive and atmospheric. The house, accurately rendered and set at some distance on the horizon line, is backed by an immense sky and a halo of drifting clouds. Although he had some difficulties with perspective (the horizontal-board fence in the view from the southwest, for example), Howard created an evocative panoramic view. Roads and fences stretch to east and west, suggesting space beyond the limits of the paper. Diminutive foreground figures contrast with the breadth of the surrounding landscape. Howard succeeded in conveying a feeling of vastness, of wide-open space—a truly New World setting for William Allan's mansion in the wilderness.

By the time the house was demolished in 1904, most of the estate had been sold off for housing. One newspaper article of the day suggested that the last few acres surrounding the house should be acquired as a park, but this did not happen. Houses were built on the site, and the park now called Moss Park was not created until many years later when the homes were demolished. A hockey arena and community centre now stand on the site once occupied by the majestic home. But Allan's mansion lives on in the two sketches its owner was far-sighted enough to commission so long ago. ■

For further information on William Allan see the *Dictionary of Canadian Biography* vol. 8: 4-13; on John George Howard see *Dictionary of Canadian Biography* vol. 11: 426-28; on André Parmentier, see Pleasance Crawford and Stephen A. Otto, "André Parmentier's Two or Three Places in Upper Canada," in the *Journal of the New England Garden History Society*, vol. 5, 1997.

By Kevin Seymour

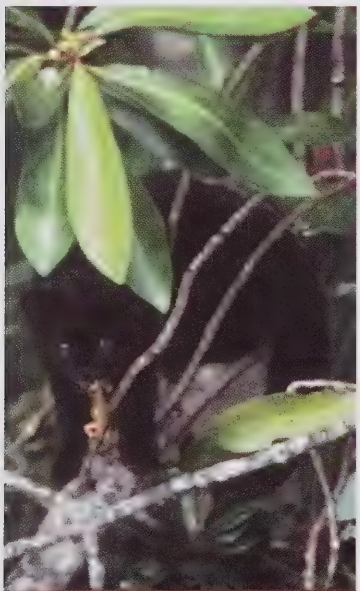
Tracing the

One ROM researcher is tackling a nearly confounding task: identifying little-known species of South American wild cats.

feline line

The Geoffroy's cat is distinguished by flecks of black on fur that varies from white to cream.

ROD WILLIAMS / BRUCE COLEMAN INC.



Closely related to the Geoffroy's cat, the kodkod is one of the least studied cat species.

JIM SANDERSON

HUMANS AND THE DOMESTIC CAT have been living together for no more than 5000 years, it is thought. Most other domestic animals—cows, goats, chickens, dogs—have been associated with us for perhaps twice as long. In a sense, people and cats are still getting acquainted. The same can be said for scientists and the domestic cat's wild cousins.

Around the globe, there are 37 wild cat species. Ten of these, more than one quarter of the total, are native to South America. The two largest, the jaguar and the puma or cougar, are reasonably well known. But among the eight smaller South American species—jaguarundi, ocelot, margay, oncilla, pampas cat, Geoffroy's cat, kodkod, and Andean mountain cat—are some of the most enigmatic cats in the world. Over the years these species have been little studied, even though for decades, culminating in the 1970s, hundreds of thousands of their pelts were shipped abroad annually as part of a lucrative and now illegal fur trade. Some of these cats are so poorly known that scientists until recently doubted their very existence.

I became interested in this group after coming across a collection of unidentified Peruvian cat fossils in the storage cabinets of the ROM's Department of Palaeobiology. In order to identify these specimens, I realized that a study of the skulls and bones of the living species was needed. Their superficial similarity meant that identifying different species would not be simple. Working on this project, I began to wonder how the cats in this group are related. Little was known on the subject although the study of relationships is an important unifying theme in biology, one that gives us a broader understanding of the context in which species evolve.

BRIAN BOYLE, ROM

Before tackling the study, I needed to familiarize myself with what was already known about each species (see "Identifying South America's Wild Cats," page 22). I also surveyed the scientific literature for existing data on relationships. Most authors agreed that the jaguarundi was an odd cat, and probably not closely related to the other seven small cat species. Recent molecular data has confirmed this earlier hunch. Further, it suggested that the jaguarundi's closest living relative is actually the puma—a surprising result since superficially they are so dissimilar: the puma is three times longer and 10 times heavier and has a relatively smaller, rounder head and longer tail. Until recently, the two species have been classified quite separately. Ironically, the first author to propose relationships among the world's cats (William Jardine in 1835) suggested just this connection—although Jardine's theory was based on the simple fact that both puma and jaguarundi are New World unicoloured cats.

There was little agreement on relationships among the other seven small cat species. The fact that each has 18 chromosomes, while all other cats in the world (including the jaguarundi) have 19, implies that these species are a clade—a group whose members are more closely related to one another than to any other species. But I still needed to determine what information could be used to resolve the question of relationships within this group. Classically, anatomical evidence falls into two key areas of examination: patterns on the animal's pelt or "skin," and the animal's skull structure. For this reason, historical mammal collections consist only of skin and skull specimens, but these days, entire skeletons and tissue samples for DNA analysis are also regularly saved.

Literature on the skin patterns was abundant and confusing. Almost 100 different scientific names were used to describe different forms or varieties of these seven cats—some were archaic and no longer in use, while others were names proposing subspecies status for animals with all manner of variation in colouring and spotting. Surprisingly little evidence surfaced about how the cats might be related. The only author to add information on skull features (Reginald Pocock in 1917) left our small South American species to the end—where they were identified only as "not having the features of any other cat species"!

The literature on skulls was equally unhelpful. Each author tended to give a general description of a typical skull, perhaps describing overall proportions. But without naming specific features, or characters, for identification—such things as the orientation of a cusp on a tooth or the relative placement of certain small holes in the skull through which nerves and arteries pass—the information was not useful for a character-based analysis. These analyses rely on distinct features that can be compared across all species under consideration. As for relationships, if any comparison was made, it tended to be with only one other species. The literature could take me only so far.

My next step was to survey a large sample of skulls of all eight species (including the jaguarundi) to see for myself what characters were present in the cat skulls. Because skulls are complex structures laden with features—compared to a limb bone, for instance, which is relatively simple in structure—they make excellent study subjects. To examine as many museum collections of cat specimens as I could, I travelled to more than 21 cities in Europe and North America.

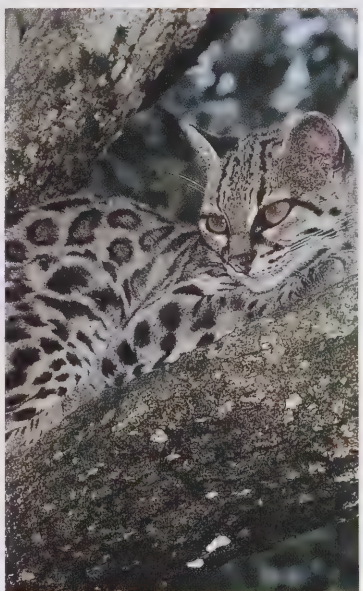
This apparently sounded like a holiday to many people: "Wow, you went to London, Paris, Berlin, Copenhagen, Stockholm, and Munich?" was the typical response. "What a great time!" In reality, six weeks of 12-hour days working alone in unfamiliar study rooms was a gruelling ordeal. As well, in these foreign countries day-to-day activities were fraught with lurking hazards: It took some time before I figured out that in Copenhagen long-distance calls must be dialled by a clerk in the post office, which accounted for the strange lack of public phone booths, and in Berlin I eventually ended up washing my clothes in the sink after an early-morning duel with a German washing machine. I always found it a relief to get back to the specimens.

I chose 40 specific features for evaluation, examining a total of 1762 skulls. While all species show a degree of variability (just look at the people around you), each has features that are more stable—or less variable—and therefore more characteristic of the species than others. The problem with my seven cat species was that the more specimens I studied, the deeper I sank into a morass of variability. *Every* character was variable, although some were less variable.

At first I focused on confirming that the individual skull identifications were correct. This in itself became a major chore because I couldn't survey characters on an individual until I was secure with its identification, yet I couldn't identify it unless I knew which characters to use for identification. This vicious cycle could be broken only with familiarity, by repeatedly examining a large series of characters on a large number of specimens. During this intensive part of the project, four museums became very important to me—because they were close by and have excellent holdings (which I repeatedly studied): the ROM, the Field Museum in Chicago, the Michigan State

The best-known and largest of the small South American cats, the ocelot has angled stripes and ocellated spots.

KEN COLE / VALAN PHOTOS

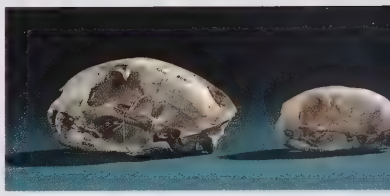


The margay's extra-long tail likely helps with balance while it hunts in trees.

KEN COLE / VALAN PHOTOS

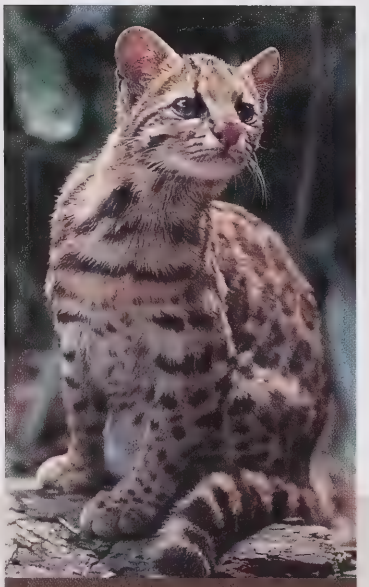
University Museum in East Lansing, Michigan, and the University of Connecticut Museum in Storrs, Connecticut.

One dreary morning as I sat in the depths of the Smithsonian Institution in Washington, D.C., surrounded by trays of specimens, I picked up a particularly unusual ocelot skull. Its large size and exaggerated crest, along with other features, had been noted in the scientific literature as representing an ocelot subspecies. Suddenly, it struck me that these features could just as likely have been factors of aging. In fact, this individual turned out to be just an old cat; it did not represent a different subspecies at all. I soon realized that many described skull features were actually age variants rather than characters of subspecies as noted in the literature.



BRIAN BOYLE, ROM

I was surprised to find that in many cases age had not been seriously taken into account in classifying the cats, even though it is well known that



TOM BRAKEFIELD / BRUCE COLEMAN INC.

The oncilla looks very similar to the margay but is missing the whorl of fur on its neck.

Identifying South America's Wild Cats

In the wilds of South America, eight species of small cat stalk the jungles and grasslands. Many of these cats are little known to either locals or scientists. Some are so elusive they have been spotted only a handful of times in the wild.

The best known of these eight species is the ocelot (*Leopardus pardalis*). About twice the size of both the domestic cat and the other small South American cats, it has a series of angled stripes and ocellated spots—that form eye-like shapes on its pelt. Although it seems logical, the name ocelot was *not* derived from the term "ocellated," but from the native Mexican name, "Tlalocélotl" (you can see why the name was shortened).

The margay and the oncilla look very similar both to each other and to the ocelot. The margay (*Leopardus wiedii*) is smaller than the ocelot and similarly patterned, but has a much longer tail for its body size. It likely spends much of its time hunting in trees, using its long tail for balance. The margay is found throughout northern and central South America and Central America up through Mexico to the southern edge of the U.S.

For a palaeontologist, the oncilla (*Oncifelis tigrina*) is easily distinguished from the margay on the basis of skull characteristics, but for a casual observer the only relatively consistent visual cues are a "normal"-sized tail (in other words shorter than the tail of the margay) and "normal" fur on its neck. In contrast, on the necks of both the margay and the ocelot is a whorl, or section of fur that grows in the opposite direction from the rest. Although the oncilla has been recorded as far north as Costa Rica, it lives primarily in South America. It has not yet been seen in the great Amazonian region, the hangout of the more common ocelot and margay. These first three species are similar enough to confound even biologists. In my research of cat skulls in various museums, most of the misidentified skulls I discovered were confusions of ocelot, margay, and oncilla.

The next four species are all found primarily in the southern portion of

ocelot *(Leopardus pardalis)*

AUBREY LANG; VALAN PHOTOS

margay *(Leopardus wiedii)*

KEN COLE, VALAN PHOTOS

oncilla *(Oncifelis tigrina)*

TOM BRAKEFIELD; BRUCE COLEMAN INC.

pampas cat *(Oncifelis colocolo)*

TOM BRAKEFIELD; BRUCE COLEMAN INC.

skulls of increasingly older age show a "trajectory" of growth normal for each species. As an ocelot grows, for example, the shape of the head changes from a kitten's—with large eyes, relatively large brain, and short snout—to a typical adult's—with relatively smaller eyes, relatively smaller brain, and longer snout—and then to an old adult's—with increasingly broader snout and apparently smaller brain due to the exaggerated growth of various crests. While the exact age of a specimen can't be confirmed, it can be roughly estimated by looking at a combination of the bone fusion on the skull, tooth wear, and growth of crests.

Once I had accounted for age variants, there were still a few atypical skulls that I could not use in my analyses until I could correctly identify them. Ultimately, I had trouble identifying only 24 of the 1762 skulls, but I also found 130 that were certainly misidentified. It is a common myth

Its distinctive striped legs mark the pampas cat although its fur patterns vary widely.

TOM BRAKEFIELD / BRUCE COLEMAN INC.

South America. The pampas cat (*Oncifelis colocolo*) is named for the habitat it occupies—which it shares with the Geoffroy's cat. Aside from its striped legs and an elongated crest of hairs along its back, the fur pattern of the pampas cat is the most variable of all the small South American cats. Its pelt can range from almost unmarked to as patterned as a margay. In 1994, it was suggested that the pampas cat's various skin patterns, which occur in distinct geographical areas, actually represent three different species. Recent DNA evidence does not bear out this idea.

The Geoffroy's cat (*Oncifelis geoffroyi*) is distinguished by its "flecks," or smallish black spots on a light background rather than ocellated spots. The background fur varies from white to cream. This species does not have a crest of hairs or striped legs like those of the pampas cat.

A close relative of the Geoffroy's cat, and one of the least studied species, is the kodkod (*Oncifelis guigna*). It is similarly flecked but overall is smaller and darker with a relatively shorter, bushier tail. Individuals that are almost entirely black (called melanistic) are common in this species. The kodkod has a restricted range, appearing only in central Chile and southern Argentina.

The least known of all the South American cats is the Andean mountain cat (*Leopardus jacobita*). It has orangish markings on a greyish background, with thick, luxurious fur and a long, thickly furred tail. With a range restricted to areas of high altitude, primarily above the tree line, the Andean mountain cat has been only rarely seen or photographed in the wild.

The last species, which is not closely related to the previous seven, is the jaguarundi (*Herpailurus yagouaroundi*). A unicoloured cat—it can be black, grey, brown, or reddish—it has a weasel-like appearance, with a low forehead, a long thin body, shorter legs, and a thin tail. The jaguarundi lives on the ground, feeding primarily on birds. It ranges from central South America north to the U.S. border.

Geoffroy's cat *(Oncifelis geoffroyi)*

ROD WILLIAMS; BRUCE COLEMAN INC.

kodkod *(Oncifelis guigna)*

JIM SANDERSON

Andean mountain cat *(Leopardus jacobita).*

JIM SANDERSON

jaguarundi *(Herpailurus yagouaroundi)*

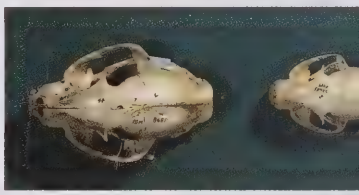
ROB & MELISSA SIMPSON; VALAN PHOTOS

that all specimens in museums are correctly identified, one that even I believed before I started working at a museum. Every institution I visited, from the smallest to the largest (yes, even the ROM), had misidentified specimens.

In the end, I was left with 16 reasonably good characters (of the original 40) to use for identifying species. For determining relationships among the species, 6 of the 16 characters were unique to one or another species, and therefore were not useful for grouping—they did not assist in aligning one species with another. The remaining 10 could be used with an additional 7 not useful in identification but that did give grouping clues. I managed to locate 5 more from the literature (skin or chromosome characters), for a grand total of 22 anatomical features by which I could try to discern possible relationships.

I input these into a computer program that would sort them into the most appropriate family groups. The answer, in the form of a branching diagram, showed three basic groupings: ocelot-margay, Geoffroy's cat-oncilla, and a third group consisting of the pampas cat, Andean mountain cat, and kodkod, as well as the unrelated jaguarundi!

I knew this was not a very good tree because I had asked the computer to use the jaguarundi and the domestic cat as outgroup species—more distantly related cats not part of the group under consideration. Twenty-two characters did not constitute much evidence, really. And the characters that did contain grouping information were, in some cases, grouping on patterns of variability. This all pointed to the conclusion that these cats, although highly variable, were essentially quite similar in their structure.

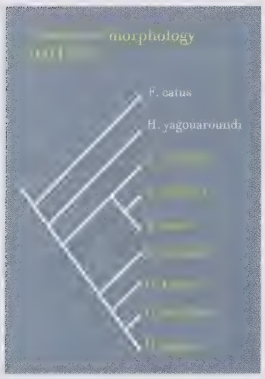


BRIAN BOYLE, ROM

There are two reasons for this. First, the continent of South America was separated from North America for most of the last 100 million years. Only recently, about 3 million years ago, were the continents re-connected via Central America, allowing cats to enter South America at that time. The oldest South American cat fossil is some 2 million years old, evidence that no cats lived there before the continents were re-joined. It is quite likely, then, that my small cat clade, now native to South America, evolved from an ancestral cat from North America. From a geological perspective, then, these cat species are all young and only recently evolved from one another—which accounts for their marked similarities.

Second, *all* cats are fairly similar to one another in internal structure with very few exceptions (only the cheetah and the sabre-toothed cats are much different). As a killing machine, the cat structure is really very effective, leaving little room for improvement. The world's cats have evolved primarily biogeographically, as likely happened in South America. This means that after an ancestral cat arrived in a new area, new species evolved by adapting to local habitats and local prey. The changes would be minimal structurally, perhaps involving only colour, size, or a behavioural trait.

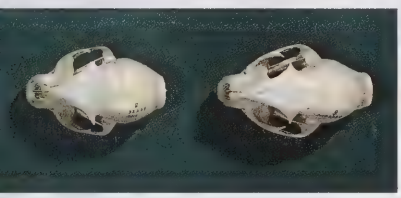
For closely related species that are similar in overall structure—such as these cats—DNA sequence data can be very useful in elucidating relationships. In this case, the DNA sequences (obtained primarily through blood samples taken from zoo animals or from pelts in museum collections) gave a similar but different answer than did the skull-character data. It showed the same ocelot-margay and Geoffroy's cat-oncilla groups, but the pampas cat and Andean mountain cat were not grouped together. Instead, the Andean mountain cat was placed with the ocelot-margay group, and the pampas cat and kodkod were placed with the Geoffroy's cat and oncilla, resulting in only two groups.



Top: This branching diagram based on skull data turned out to be misleading. Middle: DNA evidence produced a tree unlike the first, placing the pampas cat and Andean mountain cat in separate groups. Bottom: Combining the morphology and DNA data produced the same results as DNA alone.

This was another example of the much-discussed "molecules versus morphology" debate. A decade ago, when DNA analysis first became commonplace, there was an initial rush of excitement over its potential use for clarifying relationships. There was even the thought (for a brief time) that perhaps *only* DNA would be needed in the future. We now know more about the limitations of DNA, one of them being the continued difficulty in obtaining sufficient data on animals whose ancestors diverged long ago. When scientists started to discover that DNA and morphology analyses were giving different answers to the same questions, most paused for thought. Is one method right and the other wrong? How could this disagreement arise in the first place? In truth, there is almost always some conflict or disagreement between different kinds of data in such analyses. But as in this case, there is usually also an encouraging amount of agreement. One way of solving the conflict is to collect more data. But lacking more data, the challenge is to figure out a way to reconcile the differences.

Because of the trouble I had in finding stable (or non-variable) characters, I already suspected that the skull data were not very strong. There are special computer programs that can be very useful in situations like this one. They are able to search for correlations within the data and provide a relative measure of support for all the different relationship possibilities. The one I used showed that the relationships obtained by the anatomical data were relatively weakly supported, whereas those obtained using the DNA data were more strongly supported. As a palaeontologist, I found this somewhat unsettling.



Bone structure alone did not offer much evidence by which to discover the relationships of this group, and some of the evidence was misleading—although there is some agreement in the two trees. Since relationship evidence from skulls is weak, fossils will not likely be very helpful either. Yet fossils are the only evidence we have of the particular combination of characters present in species of the past. DNA is not available for these extinct creatures. Even with complete fossil specimens, the picture looks a bit bleak for the palaeontologist hoping to discover the inter-relationships of extinct cat species.

The next logical step is to combine the morphology and DNA data together in a single analysis. Increasingly, the scientific community is coming to favour this approach. It is not necessarily true that the data with a larger, better correlated set of characters "wins out" (although it did in this case, where I had 22 anatomical characters and 52 DNA characters). The smaller data set often helps to clarify a part of the species' family tree. In this case, however, the combined data produced exactly the same answer as the DNA data alone. In other words, the anatomical data did not contribute to clarifying the DNA data at all. From the DNA data alone I was able to get "the answer."

The biggest message from my study is that large samples of species must be studied before appropriate characters can be chosen for analysis. I know this to be true for cats, and I suspect it to be true for other groups of animals, too. This is even the case with DNA work: more and more studies are showing that the more DNA you sequence, the more stable the answer becomes. But even with DNA analyses, individual variability can introduce a confounding factor. Carl Van Vechten, famous for his writings on cats, once said: "There is, indeed, no single quality of the cat that man could not emulate to his advantage." That may be true, but Van Vechten clearly never realized just how hard it would be to pin down a single cat quality. ■

The least-known of the South American cats, the Andean mountain cat is recognized by its thick fur.

JIM SANDERSON

The unicoloured, weasel-like jaguarundi is not closely related to the other seven cats.

ROB & MELISSA SIMPSON / VALAN PHOTOS

Deep

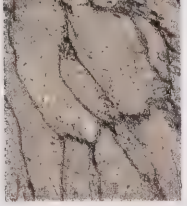
The compelling stories revealed by rocks and microscopic mineral particles chronicle Earth's history.

PHOTOGRAPHY BY DONALD W. DAVIS

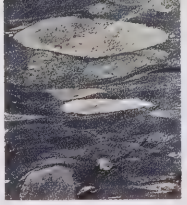
Archean gneiss near Kenora—3 billion-year-old rocks from Ontario's oldest geologic province.

Donald W. Davis

Very deep is the well of the past.
Should we not call it bottomless?
—Thomas Mann

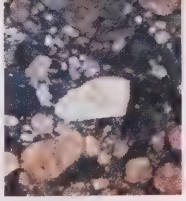


Bulbous pillow lavas that erupted beneath an Archean ocean 2700 million years ago are now locked within the continental shield.



Conglomerate near Seine River was deposited by an Archean river that flowed 2690 million years ago, then squeezed between moving blocks of crust.

Ripples in Huronian sandstone north of Elliot Lake show that this was once a beach on the continent's edge 2400 million years ago.



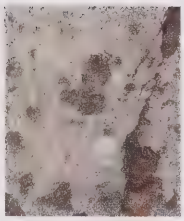
Some of the earliest evidence of glaciation—in debris flows north of Elliot Lake—were probably deposited by glacial melt water about 2400 million years ago.

time

Objects on display in museums—Egyptian mummies, dinosaurs, Greek sculpture—all hold history locked within them. But the rocks and minerals in the Royal Ontario Museum's geology exhibits have a particularly compelling story to tell. They chronicle the history of the Earth itself, the "record of Nature through countless ages" as promised on the stone-carved panel at the ROM's entrance.

Earth's memory is preserved within the rocks accumulated on its surface, the continental crust. Although rich, this record is random and incomplete. Interpreting it is like trying to reconstruct a manuscript whose pages have been torn out and scattered across the world. While geologists try to read the individual folios, it is the task of geochronology, the science of measuring "deep time," to put numbers on the pages.

One of the world's richest records of the Precambrian period, 550 million to 4000 million years ago—the age of Earth's oldest rocks—is found in the bedrock of Ontario. For more than a century, geologists have explored this ancient shield, producing increasingly detailed maps of its rocks. Early researchers used rough age estimates and broad similarities in groups of rocks to divide On-



Above: The debris of a meteorite impact explosion 1850 million years ago can be seen near Sudbury.

tario into distinct regions, called geologic provinces. These areas seemed to reflect major geological events that formed and reworked parts of the crust.

But what could have caused such events? Most of Ontario's Precambrian rocks are so ancient that the Earth's interior must have been considerably hotter than it is now, and geologists could not be sure that they formed from the same tectonic processes that operate today. It became clear to researchers that further progress in understanding how the crust formed required more precise ages, allowing the sequence of events to be reconstructed.

During the mid-1970s, the Jack Satterly Geochronology Lab (named for a distinguished scientist who pioneered geologic mapping in northwestern Ontario) was established at the ROM to develop and apply precise geochronology. Its director, Tom Krogh, had pioneered a revolutionary uranium-lead dating method using the mineral zircon (see *The Science of Zircon Dating*, page 39). Krogh continued to refine this method at the ROM, which for the past two decades has been considered the world's leading institution for the precise dating of rocks. ROM geochronologists Yuri Amelin, Tom Krogh, and John Ketchum are now exploring the limits of terrestrial time by dating the world's oldest rocks—up to 4000 million years old—from Greenland and the Northwest Territories as well as zircon grains as old as 4200 million years, which have survived in the dust of Australian sediments.

However, many of the most interesting rocks are found right in our own backyard. More than 20 years of work in our geochronology laboratory has unravelled many of the secrets of deep time, showing that the planet Earth has had an extraordinary history—and that events in Ontario played a major role in shaping it.

The Archean eon, which lasted from about 4000 million to 2500 million years ago, is the earliest time for which we have a crustal record. Most of northwestern Ontario, from Sault Ste. Marie to Kenora, comprises an area called the Superior geologic province, the largest preserved segment of Archean crust in the world. The Archean is characterized by "greenstone belts," wispy patterns of volcanic and sedimentary rocks that stretch for tens to hundreds of kilometres across Earth's surface in a "sea" of granites. Rock units within these belts, once flat-lying, are now found tilted on end, broken and folded by faults, and in places partially melted by the heat of granites that intruded from below.

These strange belts—the source of much of the world's gold and copper—are key to understanding how the Earth worked in the distant past. Previously, it was commonly believed that plate tectonics did not operate during the Archean. Greenstone belts were thought to have formed after thick piles of lava spilled onto an older continental platform, which sagged under the weight—accounting for the tilted volcanic sequences seen today. This view changed radically as a result of the work of ROM geochronologists Fernando Corfu, Tom Krogh, and myself.

The breakthrough came when we achieved the ability to date accurately single grains of zircon taken from sedimentary rocks. These grains eroded from mountains that rose as the greenstone belts were forming and, swept away

PUBLISHED WITH THE PERMISISON OF THE ONTARIO GEOLOGICAL SURVEY

The geologic map of northwest Ontario shows a pattern of wispy greenstone belts in a "sea" of pink granites. These rocks, some of Ontario's oldest, range in age from 3200 to 2650 million years.

by rivers, finally ended up in sandstone deposited along the edge of the ancient continent. While the mountains have long since eroded away, clues to their history remain within the zircon crystals that endured. The tiny grains—called detrital zircons—weigh about a millionth of a gram and may each have come from a different rock of a different age. They must be dated one at a time.

Surprisingly, the ages of the zircons showed that the youngest part of the crust is often found near its base, rather than at the top. Evidently, the continental crust was not built by newly formed rocks being deposited on top of older existing ones, as previously believed, but by successively younger layers of crust being plunged beneath one another. This is the pattern expected where tectonic plates collide. Furthermore, the ages of the sediments are progressively younger from north to south across the Superior province, suggesting that early Ontario accreted southward from successive collisions with oceanic islands. So it appears that we *can* use modern plate-tectonic theory to understand the distant past. This has led to a rethinking of geologic processes on the early Earth.

PUBLISHED WITH THE PERMISSON OF THE GEOLOGICAL ASSOCIATION OF CANADA

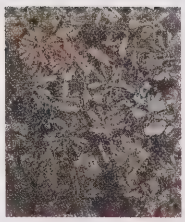
The 1267-million-year-old Mackenzie dikes stretch from the Beaufort Sea across most of the Canadian Shield, showing the massive scale of a radial dike swarm.

The birth of the Superior province 2700 million years ago may have produced the world's first "supercontinent." This huge land mass began splitting apart about 200 million years after its accretion. Rocks similar in age to those of the Superior province—and which may once have been part of it—are now found in shield areas thoughout the world. The cycle of amalgamation and dispersal of continents—called the "Wilson cycle" after the great Canadian geophysicist J. Tuzo Wilson—has continued ever since. The most recent supercontinent, Pangea, began to split up about 200 million years ago, and the crust of the Atlantic Ocean, which lies between some of the fragments, is still widening by several centimetres a year.

The breakup of continents may be triggered when superheated rock rises buoyantly from deep within the Earth's mantle. As the hot plume of rock approaches the base of the crust it begins to melt, erupting as vast floods of lava. Fortunately, these events are rare because the sudden release of huge quantities of volcanic gases might cause major climatic changes—with disastrous effects to living creatures. ROM geochronologist Sandra Kamo demonstrated that the largest mass extinction known from the fossil record—which occured between the Permian and Triassic eras 251 million years ago—coincides exactly with the eruption of the largest known flood basalt, the Siberian traps (see "Volcanoes and Mass Extinction" *Rotunda* Spring 1998). Kamo's work showed that volcanic eruptions can profoundly alter the course of evolution.

Most Precambrian lavas have eroded away, but Ontario's continental shield is criss-crossed by many generations of dikes—radiating swarms of basalt-filled fractures in the crust, through which flood lavas once flowed. The scale of some of the dike swarms is so vast that their flood lavas must once have covered much of the shield. How to date precisely these important events in the Earth's past was a major challenge because basalts do not normally contain zircon. ROM geochronologists were the first to do so using the mineral baddeleyite, which is found in basalt. In this way, ROM researcher Larry Heaman showed that the breakup of the Superior province occurred 2450 million years ago.

Shortly after, a thick sequence of sediments called the Huronian Supergroup was deposited on the edge of the rifted Superior continent. It is beautifully exposed, often as white sandstone hills, between Sudbury and Sault Ste. Marie. These rocks record what may have been the most important environmental transition in Earth's history.



Above: Magma from a mantle plume cooled 1108 million years ago to form "daisy stone" (north of Mamainse Harbour, Ontario.)

The early Precambrian atmosphere was very different from that of today, probably containing little or no oxygen. Chemically reactive uranium-bearing minerals, which would rust away in today's oxygen-bearing atmosphere, instead were eroded, transported by streams, and deposited near the base of the Huronian sediments about 2450 million years ago. In slightly younger Huronian sandstone, however, we find some of the earliest evidence of free oxygen in the Earth's atmosphere—rusted iron minerals.

The full transition to an oxidizing atmosphere took hundreds of millions of years, the result of bacterial photosynthesis. Previously, iron was soluble in the oceans, but the presence of oxygen precipitated vast deposits of iron ore. Huronian sediments deposited by melting ice also record one of the first periods of glaciation on Earth when, as in our own time, a fluctuating "greenhouse effect" drove Earth's climate between extremes of glacial and ice-free conditions.

After Huronian time, the interior of Ontario's shield settled into a long period of geologic quiescence, a period that saw remarkable biological developments. Scientists once thought that until 550 million years ago—during the Precambrian—the Earth was devoid of life. This view changed in 1954 when single-cell fossils, revealing a rich and diverse microbial ecosystem, were discovered in sedimentary rocks around Lake Superior. Zircon from a layer of volcanic ash deposited within these sediments enabled me to date the fossils to about 1876 million years old.

We now have evidence that life goes back to almost the beginning of the geologic record. Microbial fossils at least 3450 million years old have been found in Australia, and organically produced carbon in rocks from Greenland may be as much as 3800 million years old. Surprisingly, however, studies by molecular biologists, who date evolution by counting random mutations among specific genes and proteins that are shared by many different organisms alive today, indicate that most present-day life derived from a single species that lived sometime around 2 billion years ago. One interpretation to account for the discrepancy is that 2 billion years ago there occurred an event of such destructive power that it wiped out all life except for one or a few species from which all life since has evolved. If so, life on Earth may have survived by only a whisker.

What could have caused such an awesome catastrophe near the middle of Earth's history? Perhaps it was the buildup in the atmosphere of free oxygen, a deadly toxin to most early organisms. But evidence of a violent event in the Sudbury area may provide another clue. The city of Sudbury lies on the edge of a large oval body of intrusive rock. Conical shock fractures, called shatter cones, radiate through the surrounding sandstone. The north rim of the structure is a layer of Archean crust that has been turned partially on its end, apparently by the force of a tremendous explosion. Debris of exploded rock that fell from above is also preserved within the area.

The shockwave was so strong that it flash-melted part of the upper crust. The crystallization and cooling of this molten rock concentrated the metals for which Sudbury is famous.

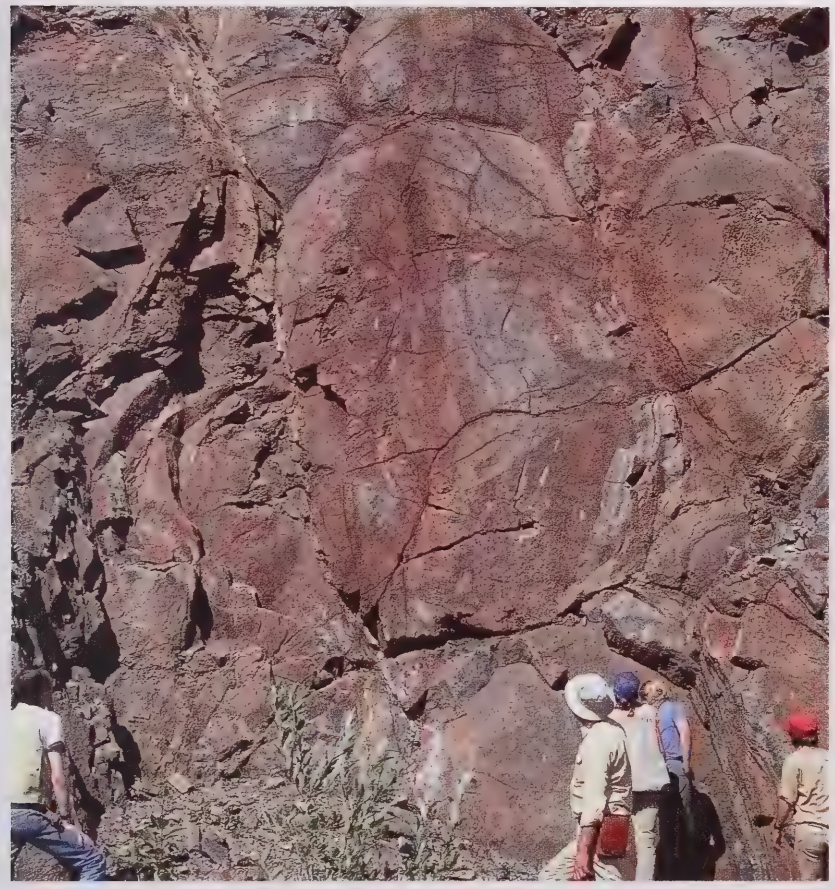
Until recently, the origin of this structure was fiercely debated. Most researchers thought it was volcanic, but a radical hypothesis suggested it was the remains of a meteorite impact crater. Tom Krogh demonstrated that zircons within the exploded rocks have tiny offsets in their crystal structure, which could have been produced only by the intense shockwave of an impact.

Based on this and other evidence, it is now generally accepted that the Sudbury structure is the result of one of the largest impact events in recorded geologic history. The shockwave was so strong that it flash-melted part of the upper crust, producing a large intrusion. The crystallization and cooling of this body of molten rock concentrated the metals for which the Sudbury mining district is famous. It also crystallized zircon. Analyses by Tom Krogh, Sandra Kamo, and myself of zircons from different parts of this body of rock all gave ages of 1850 million years. Shocked zircons within surrounding Archean rocks show massive lead loss at this time. Clearly, this is the exact age of the impact.

Sudbury was one of the first examples that started people thinking about the importance of meteorite impacts in Earth's history. Giant impacts like the one at Sudbury would have had devastating environmental repercussions. Could such violent events have modified the development of life? In a later study, Tom Krogh and Sandra Kamo identified tiny shocked zircon grains from a myste-

The Life and Deep Times of Planet Earth

Earth's fixity is an illusion that stems from the brief span of human memory. Volcanic eruptions and earthquakes hint at a more restless, unstable past, as seen in the geologic record. Over the course of human evolution (the past few million years), the pace of climatic change has been furious. Great ice sheets have advanced over the continents and melted away many times—all of recorded history fits within the span of a single interlude between glaciations. In fact, it may have been the pressures of surviving such intense environmental change that gave rise to the most adaptive organ on Earth, the human brain.

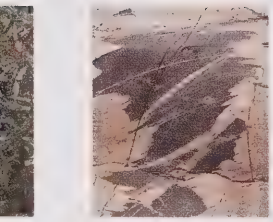


Giant stromatolite domes at Steep Rock near Atikokan, Ontario, were made by living organisms about 3000 million years ago.

But human evolution barely ripples the surface of the well of time. Plunging downward into what Earth science writer John McPhee called "deep time," the face of the Earth itself constantly changes as continents collide and drift apart. The ocean crust lasts only about a hundred million years between its birth at mid-ocean ridges and its descent back into the Earth's mantle. The continents are carried across the globe on tectonic plates, the lighter rocks of the continents "floating" above sea level on the denser mantle beneath. Water and ice break the rocks apart to form sediments, and dissolved atmospheric gases liberate the elements essential to life. The calcium in our bones once resided in feldspar crystals in rock. The carbon in our bodies once was part of the air. Life exists by virtue of the ongoing exchange of materials between parts of the Earth. Its origin and evolution are an inevitable consequence of geologic forces on this active planet.

Certain places evoke a palpable sense of deep time. One of them is at the Steep Rock iron mine, near Atikokan, Ontario. Rising from the wall of a cliff are large marble domes up to 5 metres (16 or 17 feet) across. These domes were once alive: They are the remains of bacterial colonies called stromatolites that have lain here for almost 3000 million years, from the very beginning of the geologic record in Ontario. Yet living stromatolites are still seen today in hypersaline tidewaters. Geologically, Steep Rock is hallowed ground, a unique place that echoes the vast and unbroken history of life on Earth.

Fossilized life first gave us the means to deal with the geologic past, because its evolving forms can be ordered in time. By painstakingly classifying and correlating fossils from layers of sedimentary rock, palaeontologists determined the relative ages of many rocks, but they had little idea of their absolute ages. We now know that the last dinosaurs died out 65 million years ago, which seems an enormous leap backward, but this is only a tiny fraction of time on Earth. The first appearance of animals with hard parts, the beginning of most of the fossil record, was only about 550 million years ago. Preceding this is the Precambrian period, going back to 4000 million years, the age of the oldest preserved rocks. What existed before that must have been a world too violent for rock to survive in for long. The oldest objects that you can hold in your hand, mineral grains from the Allende meteorite, condensed out of the solar dust cloud 4566 million years ago. The Earth took another 50 million years to accrete from collisions between such meteorites. Finally, a giant collision with a planet-sized body left an ocean of molten rock on the surface of the newly born Earth, and in space, debris from which the moon coalesced. Compared to Earth's beginning, the dawn of our own species goes back to only a hundred thousand years ago—two seconds before midnight on the first day of creation.



rious dust layer thought to have been laid down by an impact in Mexico that coincided with the sudden disappearance of the dinosaurs 65 million years ago. They analyzed the grains for uranium and lead isotopes (see "Cataclysmic Insights into Extinction" *Rotunda* Summer 1994), finding that most of the zircons crystallized 550 million years ago but were disturbed about 65 million years ago—the time of the impact. That meant the rocks beneath the impact crater should be 550 million years old. The age of the rocks at the bottom of the Chicxulub crater in Mexico matched—the critical evidence for a "smoking gun." Although we are accustomed to think of geologic processes as slow and gradual, such research shows that devastating and irreversible planetary change can also happen in a matter of seconds.

While life developed on the Earth's surface, the interior of the Superior province was once again caught up in the drama of geologic events. About 1108 million years ago, a mass of superheated mantle rock rose beneath the crust in what is now the Lake Superior region, setting off a gigantic tug-of-war over the fate of North America. Sheets of molten rock erupted and intruded for hundreds of kilometres between the continental basement and its sediment cover. Their eroded remains are still visible around the Thunder Bay area. Elsewhere, basalt lava coursed over the surface in flows up to a kilometre thick.

Under the force of this volcanism, a rift valley began to open up and water circulated through the hot volcanic rocks, producing rich copper and silver deposits. This process continued for another 20 million years before the rift valley began to close, apparently snapped shut by the force of the Grenville collision to the east. If not for this, the continent may have split apart and formed a new ocean.

Above: Caught between colliding continents, part of a basalt dike in Georgian Bay was pulled apart and stretched during the Grenville 1100 million years ago.

The southern edge of the ancient Superior continent may have seen the birth and death of several oceans before the Grenville province formed more than a billion years ago. The folded and contorted rocks of the Grenville can be seen across the Georgian Bay and Muskoka areas. Such rocks are discontinuously exposed in a belt that runs from Mexico through Ontario and across to Scandinavia. They are the remains of a continental collision that produced another super-continent, now long-vanished, called Rodinia.

The Grenville province has been a lifelong study for Tom Krogh. By dating zircon from these rocks, Krogh and others can begin to understand the play of events as continents form. About 1100 million years ago, thick sheets of crust were thrust on top of one another, probably creating a chain of mountains through southern Ontario. They were derived from fragments of islands and continental margin rocks that piled up as ocean crust between approaching continental plates was swept down into the Earth's interior. After the continents joined, the mountains began collapsing outward under their own weight. This collapse plus hundreds of millions of years of erosion have left only the tortured rocks at their base. Though the mountain chain no longer stands, we can still document its existence and get a detailed picture of its creation and demise—all from the minerals contained within these rocks.

A mass of superheated rock rose beneath the crust in the Lake Superior region, setting off a gigantic tug-of-war over the fate of North America.

Around 450 million years ago, Ontario's eroded shield was flooded by a shallow tropical sea. The fossil-rich limestone reefs left behind from this era form much of the bedrock of southern Ontario and the James Bay lowlands, now overlain by the debris of recent glaciers. The rest of the fossil record is missing in Ontario. Ironically, fossils that were once used to help scientists estimate relative ages of rocks are now themselves dated using zircons taken from layers of volcanic ash that were occasionally deposited within the sediments.

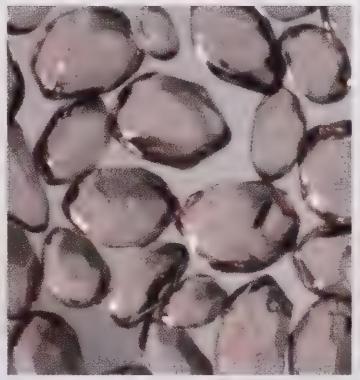
The rocks of Ontario provide a living record of Earth's history that can be seen and touched by anyone who drives across it. But a geologic province is no more interesting as a cryptic collection of rocks and minerals than is history as a series of unconnected events. Geochronology gives context and meaning to the rocks, information that is fundamental to understanding the Earth. Largely as a result of work at the ROM's geochronology lab, much of the rock record in Ontario and many other places in the world can now be interpreted. The lab is a uniquely powerful tool that enables us to view deep time in a detail never before possible. It has revealed a more extraordinary story than early geologists ever imagined. ■

The Science of Zircon Dating

MEASURING THE AGES of rocks is the heart of our work in the Jack Satterly Geochronology Lab. To do this, we need something inside the rocks that changes at a slow but regular rate, like an hourglass. Several such clocks exist, all of them based upon the slow decay of unstable atoms called radioactive isotopes. These are named for the element followed by the mass of the particular isotope—carbon 14, for example.

Radioactive isotopes decay randomly, but each one has its own precisely defined average rate of decay called a half-life—the time taken for half of the isotope's atoms to decay. Unlike an ordinary hourglass, the sand—or radioactive atoms in this case—reduces itself by exactly half in a given time interval, then half of what is left disappears in the next interval, and so on. In theory, the sand—or atoms—should never completely run out. In practice, however, there is so little left after about 10 half-lives that it is impossible to measure, and the isotope is considered extinct.

Carbon 14 is continually made in the upper atmosphere by cosmic rays. With a half-life of 5700 years, this isotope is useful for dating events in human history. But carbon 14 is an exception—most of the Earth's elements were made during massive stellar explosions before the formation of the solar system almost 4600 million years ago. Their radioactive isotopes have mostly long since decayed away. But a few decay so slowly that some still remains today, and these can be used to date rocks.



Top: Zircon: Earth's hourglass. These crystals began marking time 2732 million years ago. Bottom: Mass spectrometer: Geochronology's tool for counting atoms of lead and uranium inside zircons.

The element uranium is particularly useful because it contains two long-lived isotopes—uranium 238 (with a half-life of 4470 million years) and uranium 235 (with a half-life of 704 million years). Because each decays into a different lead isotope—uranium 238 into lead 206, and uranium 235 into lead 207—the uranium-lead radioactive decay system gives us two clocks in one, making it uniquely powerful for measuring ages.

Uranium is easily oxidized and dissolved out of rocks near the Earth's surface, so uranium-lead ages on whole rocks are usually unreliable. Fortunately, nature has provided us with an extremely useful mineral host in the form of zircon—a hard, inert mineral that looks like tiny diamonds under a microscope. Zircons crystallize from molten rock as it solidifies in the continental crust. The zircons concentrate uranium but exclude lead as they form. Each newly formed zircon is like an hourglass with sand in the top—the two uranium isotopes—but none in the bottom, since zircon contains no lead. Over the lifetime of the rock, the two "parent" uranium isotopes decay into two "daughter" lead isotopes at different rates. Since we know exactly how fast they both decay, we can determine two ages by measuring the ratio of each parent uranium isotope (the sand left in the top) to its daughter lead isotope (the sand accumulated in the bottom).

In our lab, zircons are separated from a few kilograms of crushed rock using magnetic fields and dense organic liquids that float off most of the other minerals. But things can get complicated in cases where some of the daughter lead has leaked out of the zircons as their crystal structure becomes damaged over time.

Fortunately, geochronologists can easily identify results from leaky zircons because the ages given by their two uranium-lead decay systems do not agree. The first challenge is to isolate undamaged zircon crystals or parts of crystals. The ROM lab's solution was to microscopically identify and select zircons with no visible damage, then abrade off the outsides of the grains in a small compressed air chamber. This process, introduced by Tom Krogh in 1982, revolutionized the field of uranium-lead geochronology—it enabled geochronologists for the first time to work routinely with undamaged zircon.

But most zircons in Precambrian rocks are still too altered to be dated with accuracy. It is necessary to recognize and extract the tiniest unaltered portion, the part that retains an accurate memory of the age. A second challenge is to analyze these tiny grains without contaminating the sample. The lead in a single zircon may amount to only a few millionths of a microgram, so analyses must be done under ultra-clean conditions. Because the ROM lab has always had the lowest contamination levels in the world—less than half a picogram of lead (one picogram is a millionth of a millionth of a gram)—we have been able to date samples that could not be effectively worked on anywhere else. These methods give us very accurate ages (to within 1 million years) on Precambrian rocks.

Deep within a cave in a remote corner of Croatia, researchers have uncovered what may be the key to understanding a little-known ancient Illyrian civilization. After lying undisturbed for millennia, the evidence has at last come to light.

By Tim Kaiser

M. DARMANIN

It was the summer of 1999. I was with a small team of archaeologists, quietly

The Secret Chamber

"It's dark back there." Lara called out, "come have a look."

ng to unravel a minor part of Mediterranean prehistory by digging in a remote Croatian cave.

Now, at the end of what had been a modestly successful season, we were about to discover that our cave, Spila-Nakovana, was not what it seemed. It had a secret.

Beyond what appeared to be the back wall of the cave was a concealed gallery, a vast space hidden for millennia. Inside we were to find the undisturbed remains of an ancient Illyrian sanctuary—one that has since begun to shed new light on some of the most fascinating "barbarians" the Greeks ever encountered. Nothing like this site has been seen before in the eastern Adriatic or, for that matter, anywhere in the Hellenistic world.

TIM KAISER

Nakovana Cave overlooks the Adriatic Sea from just below the crest of a high ridge on the Pelješac peninsula, 100 km (66 miles) north of Dubrovnik on Croatia's Dalmatian coast. It perches above a small basin of karstic limestone overgrown with the maquis scrub so common in the Mediterranean. In the distance, the sea stretches to the neighbouring islands of Korčula and Hvar. "Remote" barely begins to describe the peninsula. Hanging on to the mainland by a fingernail, rugged Pelješac is so unfrequented that it is still home to a large population of jackals, who can be heard howling almost every night.

ROM-sponsored archaeological research has been underway in the Adriatic region for more than 10 years. While the ancestral peoples and cultures of this region actively participated in the development of the Mediterranean world, their roles are not well understood. Prominent among those people were the Illyrians. Speakers of an Indo-European language, the Illyrians were the indigenous inhabitants of the Balkans north of Greece, from at least the 2nd millennium BC. The Greeks, who supply us with our first accounts of the Illyrians, regarded them as pirates and brigands, formidable opponents who came to play a significant role in the balance of East Mediterranean power.

TIM KAISER

In the closing centuries of the 1st millennium BC, contact with the imperial, urban powers of the Mediterranean stimulated rapid political change in what had been no more than a loose confederation of chiefdoms. By the 3rd century BC there was a new power on the Adriatic coast. Under Queen Teuta, the Ardiaei—an Illyrian group of the south Adriatic—periodically raided cities in Greece. Sailing in *lembi*—small, fast warships with a single bank of oars and carrying 50 soldiers—Illyrians were probably a familiar threat in northwest Greece.

The Illyrian lands finally fell under Roman control in the 1st century BC after a long and grim series of campaigns waged by the Roman legions against one Illyrian group after another. By 59 BC, when command of the region was given to Julius Caesar, the Romans were using the name Illyricum to refer to their territories on the Adriatic.

Although the Illyrians did not come to share the lot of the Vandali, whose name became synonymous with bad behaviour, the Illyrians were nonetheless roundly despised by the Greeks and Romans who wrote about them. What exaggerated accounts survive are not balanced by much countervailing archaeological evidence: few Illyrian settlements or cemeteries have ever been excavated.

Nakovana Cave first attracted our attention because it promised to shed light on these little-known people of antiquity during a number of particularly poorly understood periods, the Neolithic and the Copper Age. In the early 1970s, archaeologist Nikša Petrić of the University of Zagreb had dug briefly at Nakovana, discovering a type of pottery that came to be recognized as the hallmark of the early Copper Age (approximately the first half of the 4th millennium BC) throughout the eastern Adriatic. I say "approximately" because the Nakovana Culture, as it is now called, has never been accurately dated. Carbon 14 testing was beyond the scope of Petrić's paper-thin budget. Yet this stretch of uncharted time covers the period immediately before the emergence of the first hereditary elites of the Bronze Age. Nakovana Cave was a site of unfulfilled promise.

My team and I first arrived in July 1999, planning to work for a month. From the outside, the cave looks like a slit cut at a shallow angle back into the limestone: 2 metres (6½ feet) high, 20 metres (65½ feet) wide, and 16 metres (52½ feet) deep—or so it first appeared. Low stone walls at the front of the cave indicate that Nakovana was used by local herders to shelter their flocks. We found that Petrić's old trench was still open, now more a crater than anything else. Our first job was to clean off a portion of the still-exposed stratigraphic profile—the cross-section of ancient layers deposited one upon another over time—and then to dig a 4 square metre (4¾ square yard) area around the old trench.

As we had hoped, the new excavation uncovered a series of artifacts from the early Bronze Age, the Copper Age, and both the middle and late Neolithic. We reached the bottom of Petric's trench at a depth of 2.15 metres (7 feet), but at that depth he had not yet reached bedrock. The strata contained large amounts of charcoal among the moderate numbers of artifacts; together these would be enough to generate a series of radiocarbon dates back in our lab.

M. DARMANIN

Previous page: Tim Kaiser crawled through a hidden passageway to find evidence of an Illyrian civilization. Top left: After digging down more than 3 metres (10 feet)—to a time period of 8000 years ago—the researchers have yet to hit bedrock. Bottom left: maps of Croatia and Pelješac area. Above: The back chambers of the cave, hidden behind a wall of scree, were littered with pottery fragments.

Toward the end of the season, I noticed bats flying into the cave and disappearing at the back. Looking more closely, I saw that where the scree met the downward curve of the ceiling there were occasional holes. That's when I began to suspect there might be a space behind the cave's back wall. In other Dalmatian caves, such spaces have sometimes yielded one or two large pieces of Bronze Age pottery—vessels cached there long ago for safekeeping.

In the hope of finding something similar, we started to pull away the rocks. To our surprise, we found that the scree choked a low passageway, a crawl space less than a metre (3 feet) high with stalactites dripping from the ceiling. There was barely enough

room to wriggle forward on our bellies. The passage sloped downward into the dark for 5 metres (16 feet). At the end, far from finding the back wall, we found instead . . . astonishment. The cave continued.

The passage opened out into a space high enough for us to stand. We were in a long gallery consisting of two chambers, up to 4 metres (13 feet) high and up to 7 metres (23 feet) wide, with a massive chimney between them. In all, the cave was almost three times longer than we had thought.

TIM KAISER

A stalagmitic crust (re-crystallized calcium carbonate) covered parts of the surface. Close inspection showed it was undisturbed. The back of the cave had obviously been sealed off some centuries before. Since then, no one had set foot in these chambers.

As we flashed our headlamps around the space we could see the glint of hundreds of pottery fragments scattered on the floor. A few were pieces of Bronze Age jars and bowls we recognized as dating to ca. 1500 BC, but most were made in the last half of the 1st millennium BC. Local Illyrian Late Iron Age pottery, ca. 400 to 50 BC, mixed with a profusion of contemporaneous Hellenistic Greek ceramics, littered the floor of the cave. The fragments were large and, judging from their associations, appeared to have been largely left where they had been broken.

The densest cluster of pottery was found around the cave's dominant feature: a single, towering 1.25 metre- (4-foot-) high stalagmite set squarely in the centre of the cave's middle chamber. Not only was this stalagmite eye-catchingly large, but its shape was unmistakably phallic. There were no comparable stalagmites in the chamber, and—most curiously—no corresponding stalactite dripped from above.

Within the first few minutes, we knew we had made a very unusual, and very important, find. The pottery, virtually all of it fine ware, was exceptionally well preserved and of high quality. Such ceramics are associated with ritual sites of special significance. This chamber was obviously a sanctuary. For an archaeologist, there is no greater treasure than finding such a site—especially one that is undisturbed.

After confidentially reporting our find to the national authorities, we sealed up our tunnel and left to plan a proper campaign. In July 2000 I returned with colleague Dr. Staško Forenbaher of Zagreb's Institute of Anthropology and a multinational team of archaeologists. Over the summer, we

carefully stripped away the layer containing Hellenistic and Illyrian pottery in the middle chamber. We staked out a 40-square-metre (430-square-foot) grid around the phallic stalagmite, sectioned into half-metre (1½-foot) units, and began excavating. The sediments were moist and clayey—too sticky to be trowelled or sieved in the usual manner. Yet they contained extremely high densities of artifacts.

Our solution was to remove the Hellenistic layer one square at a time, then wash the sediments through a graduated series of screens that catch even the smallest artifacts. In one 25 x 25 centimetre (10 x 10 inch) area alone, the layer was a mere 15 centimetres (6 inches) thick, but yielded more than 3.5 kilograms (7½ pounds) of pottery—650 potsherds in total. Ultimately, we bagged 3 metric tonnes (2.9 tons) of sediments and artifacts, and backpacked them down the hill to our makeshift laboratory for wet-sieving, conservation, and analysis.

This work revealed further characteristics of the cave. We found that the large stalagmite sits between a shallow transversal trough and a deeper pit, both dug during Hellenistic times, 2300 years ago. The pit showed signs of having been filled periodically with water. Might it have been a lustral basin? Surrounding these features were scattered patches of charcoal and a number of broad flagstones.

As we worked, periodically the generator that supplied power to our lamps would come to a coughing halt—and it became clear why the stalagmite was placed in its exact location. Because the cave is oriented east to west, a ray of daylight filters from the cave's mouth through the small channel that was once the ancient entrance to the middle chamber. From there, it strikes the stalagmite, illuminating it, and it alone, like a spotlight. The monument throws a long shadow, intensifying the impression of size.

Digging beneath the phallic monument itself, we found it rested atop a series of prehistoric layers. Hearth remains (ash, charcoal, and pottery) of the late Neolithic (ca. 4000 BC), suggested that the stalagmite must have been moved to that spot sometime afterward—it could not have grown there so quickly. The layer containing Hellenistic pottery ran up against the stalagmite, which must therefore predate the 4th century BC. From this stratigraphic evidence, we can conclude that Nakovana Cave served as an important sanctuary for centuries, if not millennia.

The daunting task of pottery analysis began immediately. Many of the thousands of potsherds could be fit back together—after much trial and error—to form scores of vessels. As the reconstruction proceeded, we were struck by the consequences of a number of observations. First, the Greek pottery was exceptionally well preserved, its painted colours still vivid. These were museum-quality pieces.

BRIAN BOYLE, ROM

Left: The towering stalagmite, unmistakably phallic in shape, found in the centre of the cave's middle chamber, suggests this was the meeting place of a cult. Above: More than 80 percent of the vessels in the cave were fine wares. A 3rd-century BC wine cup from Corinth (far right) bears an apparent dedication to Aphrodite.

Second, the ceramics were almost all fine wares dating from the 4th to the 1st century BC. Skyphoi (small pedestalled cups), unguentaria (perfume bottles), black-gloss-and-relief-moulded plates, miniature amphorae, and other vessels were all well represented, accounting for more than 80 percent of the ceramics. So much fine ware at one site is unusual. Normally vessels used for cooking or storage are more numerous.

Third, these fine wares were mostly imports. The delicate, thin-walled Greek pottery came from a variety of sources around the Mediterranean, and a few pieces of faience were even from distant Egypt. Some of the polychrome painted vessels originated in Gnathia, a Greek colony in south Italy; other ves-

sels came from the Greek mainland, from Athens and Corinth. Surprisingly, there was little locally produced pottery.

In the Greek world, and in the world of neighbouring countries, fine ware ceramics in such great numbers indicate a ritual site—a shrine. In the sanctuaries of antiquity, leaving votive offerings, including food and drink, was a customary ritual practice. And the vast majority of the ceramics lying broken on Nakovana's floor were cups, jugs, bottles, and amphorae—drinking gear, in other words. It seemed likely that these vessels had been purposefully smashed, because we found fragments of broken stalactites mingled with the potsherds. Presumably, the drinkers would toss their cups in the air, sometimes striking the ceiling above and causing the fragile stalactites to fall to the ground. Rounding out this picture of riotous drinking is evidence of feasting, the bones of lamb and kid.

But the most telling piece of evidence was a 3rd-century BC *kantharos*, a wine cup, from Corinth. Lying broken next to the stalagmite, it bore a *graffito* scratched onto its buff surface—an apparent dedication to Aphrodite, the Greek goddess of love and beauty. Nakovana Cave must have been an Illyrian sanctuary probably related to a fertility cult, a ritual celebration of potency. The association of copious alcoholic consumption with a phallic monument suggests the possibility of Dionysian behaviour, with all its attendant orgiastic excesses.

The ritual consumption of alcoholic beverages was an important symbolic act in the Greek world. Indeed, ancient Greek drinking rituals were quite elaborate, prescribing the use of certain kinds of vessels when making particular offerings or dedications. Finding such specific items as the Corinthian *kantharos* in Illyrian hands raises the interesting question of whether the Illyrians were faithfully adopting Greek customs along with Greek goods, or whether Illyrian traditions were simply being dressed up with novel cultural items.

To understand more, we needed to find a broader context for the cave. We decided to inspect the micro-region for clues. A two-kilometre walk from the cave leads to the base of a towering hill fort called Grad, which dominates western Pelješac. Grad has been known to scholars for some time, but has never been studied. We spent several days investigating Grad and its vicinity, discovering still-standing architectural features. Judging from these, together with the pottery we found, the site was occupied most intensively during the Hellenistic period.

Interestingly, a few pottery pieces from Grad were virtually identical to those found within the cave sanctuary. Beneath the hill fort, ancient terraces and field systems are still partially visible. And ringing the whole area were some 70 stone burial mounds, many of them seemingly undisturbed—all archaeological indicators of power and wealth. Evidently, in the Late Iron Age, western Pelješac was a significant Illyrian stronghold.

Trade with the rest of the Mediterranean world was a critical factor in the political economy of the Illyrian chiefdoms of southeastern Europe. It is believed that Greek and Etruscan goods were imported by Illyrians (and, elsewhere, by Celts) who used them as prestige objects in their most significant social transactions. By the same token, trade with their "barbarian" neighbours was a significant activity for the Greeks, for it provided Greece and its colonies with raw materials, slaves, and other commodities.

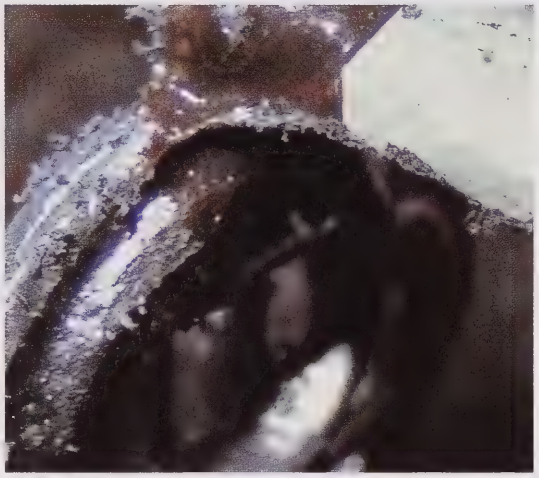
At the tip of Pelješac, the residents of Grad occupied a very favourable position. The channels on either side of the peninsula were used by ancient mariners travelling north to the head of the Adriatic and thence to the Alps or toward the Neretva delta and the Balkan interior. Perched on their mesa top, the people of Grad were well placed to intercept some of the richest cargoes of the day. Piracy in the eyes of some, good business to others, it all came down to the same thing—a constant flow of wealth, part of which was left behind in the dark recesses of Nakovana Cave.

The immense good fortune of being able to examine the undisturbed archaeological site at Nakovana Cave opens a window on a fascinating piece of the past. Just how far into antiquity the story goes cannot yet be said. After digging down more than 3 metres (10 feet) in some parts of the cave—representing a time period of more than 8000 years ago—we have yet to hit bedrock. Thanks to generous funding from Audrey and David Mirvish, the project will continue for another two years, giving us the opportunity to learn more about the secrets of this relatively unknown ancient civilization. ■

For further information about the ancient Illyrians, visit the Web site http://www.dalmatia.net/croatia/history/illyrians.html.
For general information about Croatia's history, try http://www.dalmatia.net/croatia/history/www-vl/index.htm.
The book *The Ilyrians*, by John Wilkes (Oxford: Blackwell Publishers, 1992), is an authoritative yet readable account.

How Soldiers Keep their Shine

Who's afraid of a little lead rot? Toy soldiers are. Herewith, a guide to the disease's dangers and how to guard against it.



SUSAN STOCK, ROM

BRIAN BOYLE, ROM / 991.246.187.1-28 SET 2186

Left: Lead formate corrosion has grown on this lead soldier. Below: Additional corrosion can be seen on the same figure, especially on the French horn and helmet. Next page: The figure is part of the Bahamas Police Band set, made in 1959, from the H. N. R. Jackman Collection of Toy Soldiers.

SUSAN STOCK

Some collections are amassed by accident. Items once utilitarian that lurk in the back corners and attics of many households can suddenly become collectibles. As such, their value escalates, sometimes into the stratosphere, and owners take a second look at what they've got. Other objects, perhaps obtained and highly prized for purely sentimental reasons, may assume another level of interest with their increasing dollar value. But beyond reasons of value and sentimentality, many collections are made purely for the joy of collecting. The hunt for something rare, or bringing together sets of objects that have long been disbanded, can be a thrill in its own right.

Some months ago, I shared an afternoon with a group of enthusiasts who collect toy soldiers. They meet to exchange information, trade items, and enjoy time with others who share their appreciation. The event focused on care and storage of their miniatures, most specifically on an upsetting destructive phenomenon they called lead disease or lead rot. Though I know little about collecting toy soldiers, I do know quite a bit about lead and its corrosion phenomena. At the end of the afternoon I promised to write some guidelines for the collectors on preventive measures and the safe storage of their toy soldiers; this article is for them, and all those who collect lead artifacts.

Since antiquity, lead has been a well known and popularly used metal. Considered stable, the toxic metal is known to have survived burial in the ground for several thousand years due in part to a stable, protective layer of corrosion—composed primarily of lead carbonate (cerussite) and basic lead carbonate (hydrocerussite)—which forms under certain burial conditions. As a roofing material, too, lead is durable, long surviving exposure to the elements. The average lifespan of a lead roof is about 150 years, but in some climates it may endure for hundreds of years longer. The lead roof on the Pantheon in Rome, dated 1601, is an example. Again, its longevity is due in part to the formation of a protective, insoluble corrosion layer—in this case largely composed of lead sulphate but including lead carbonate and basic lead carbonate.

Although under most conditions lead is considered a relatively non-reactive metal, it is readily and aggressively attacked by organic acids and other volatile carbonyl compounds (see "Safely Stored?" Winter 1994/95 *Rotunda*). The most common organic acids are acetic acid, also known as vinegar, and formic acid.

These acids are given off by numerous substances—many woods and wood by-products, the adhesives used in plywood, polyvinyl acetate adhesives, cardboard, the white glues, some latex paints, and many of the finishing products used on wood cabinets. Many urethane finishes decompose into formic acid.

Of the woods, oak, although a favourite cabinet material, must be avoided at all costs. It is known to off-gas particularly high quantities of acetic acid and does so over long periods of time. In a closed or sealed environment, the concentration of these contaminants only escalates—reaching levels far beyond the few parts per million needed to cause lead corrosion.

In the presence of moisture, oxygen, and carbon dioxide (CO_2), lead is attacked by acetic acid, forming soluble, but unstable, lead acetate. In contact with air, carbon dioxide (CO_2) combines with the lead acetate to form a light powdery white basic lead carbonate called hydrocerussite. It's the hydrocerussite that we call lead rot or lead disease. This reaction is particularly damaging because once hydrocerussite is formed, it releases the acetic acid, creating a fast-paced cycle of destruction. A similar process occurs in the presence of formic acid.

Some scientists suggest that the corrosion cycle is electrolytic in nature, with the lead acetate as the electrolyte, the metal as anode, and the corrosion crust as cathode. In both equations, high relative humidities provide the moisture necessary to create the reaction. The higher the relative humidity, the more active the corrosion; therefore, keeping your lead objects dry will reduce the risk of corrosion. It was once thought that because lead was stable, it did not require a dry environment with low relative humidity, but that notion has changed.

Recently, a technician in the Department of Western Art and Culture noticed crystallization on a small group of toy soldiers that were stored in close proximity to the Period Rooms in the ROM's Samuel European Galleries. The rooms are afflicted with a chronic unsolved problem that results in the rapid tarnishing of silver. It was hoped that the silver grey plumes of corrosion appearing on the toy soldiers were caused by elevated levels of hydrogen sulphide—indicating a link to the tarnish situation. However, analysis showed the corrosion to be lead formate and therefore not related to the silver tarnishing at all. Interestingly, only this group—the Bahamas Police Band—was affected. This set of soldiers must have been exposed at some point to formic acid.

BRIAN BOYLE, ROM

Actual treatment of our toy soldiers will be complicated. One of the difficulties is the discontinuous paint layer and fears of causing further paint loss. Since I am a firm believer in the "less is more" method of treatment, I have chosen to remove the pieces from the suspect environment. They are presently under observation and so far there has been no further change.

Hobbyist literature suggests treatments that involve the soaking of corroding objects in various solutions and other procedures that I do not consider necessarily effective or safe. Once corrosion has begun, it can be a fairly difficult—and dangerous—matter to treat or stabilize your objects. This is best done by, or in consultation with, a trained conservator. Lead corrosion is TOXIC. It should not be blown into the air or vacuumed.

One technique that has proven successful in the past is removing loose powdery corrosion from localized areas by swabbing with a cotton wool swab dampened with distilled water. All loose corrosion frass can be removed taking care not to flood the object with water. Swabs should be collected and disposed of according to local by-laws. Individuals undertaking this procedure should wear appropriate respirators and gloves. It should not be done in food-handling areas or near children's play areas. The procedure is very simple—and if it works why do more?

Various magazine and newspaper articles suggest that paint coatings, varnishes, or nail lacquers will protect lead from corrosion. This is not the case. The barrier provided by a paint layer is permeable to corrosive vapour molecules and therefore, at best, can only be considered a retardant. When these coatings are broken, uneven, scratched, or otherwise compromised, corrosion is further enhanced by galvanic action. If all acid vapour is not removed, it remains beneath the object's lacquer barrier and continues to corrode it. Do not rely on protective coatings applied to your objects.

Overall the best and simplest advice is to store your lead soldiers in an inert, dry environment. Construct display cases from glass, plexi-glass, stone, or a metal that is either uncoated or treated with conservation-approved coatings. Keep your objects (those with no organic components) as dry as possible, preferably at a relative humidity of less than 35 percent. Keep lighting out of showcases to prevent fluctuating temperatures and relative humidity and keep objects out of direct sunlight.

If you follow these guidelines, your toy soldiers should remain stable for years to come, and the joy of collecting them will be undiminished.

Susan Stock, the ROM's archaeological metals conservator, trained at the Institute of Archaeology, London.

CULTURE, ART AND DESIGN

Made to Move...

Its size and portability made this desk ideal for 19th-century women on the go and may account for its presence in many places beyond the home—including Ottawa's corridors of power

Dear ROM Answers,

The enclosed photographs show a desk that my mother purchased in 1951 for $35 from an antique shop on Yonge Street in Toronto. She was told it was a Victorian-era schoolteacher's desk. A couple of years ago, I saw a virtually identical desk at an antique show at Sherway Gardens mall. The dealer said it was the kind of desk used by a member of Parliament, although he did not know which member, nor which parliament. As I recall, it was priced at about $700.

My desk appears to be made of oak and is 94 centimetres (37 inches) high by 68.5 centimetres (27 inches) wide by 61 centimetres (24 inches) deep, with a sloped writing surface, which forms the lid of the desk. On the right-hand side, there are four drawers, the handles for which are missing (the bottom drawer has been removed in the enclosed photo). Each drawer has a small lock operated by a skeleton key. Above the four drawers is another small, square drawer with a turned wooden knob. It contains an inkwell and a curved removable tray that appears to be designed to hold pens or pencils. On the left side, there is a door to a small cupboard.

The desk had several coats of paint on it when purchased, which my father stripped off. He also replaced the worn leather insert in the top of the desk.

I know nothing about the furnishings of Victorian-era schools, but I surmise that this is a bit too fancy for anything that a public-school teacher might have been equipped with. Can you tell me the approximate age and purpose of this desk, where it might be from, and what kind of handles might have originally adorned it? Thank you very much.

J. M., Toronto

J. M. TORONTO, ONTARIO

PETER KAELLGREN

Dear Reader,

Judging from your photographs and your excellent description, you own a davenport desk from the Victorian period. These small moveable desks were named for a Captain Davenport, said to have ordered one from the popular furniture-manufacturing firm of Gillows of Lancaster towards 1800.

The essential characteristics of such desks are their small size, the castors on all four uprights, which allow them to be moved, a hinged writing slope that serves as a cover for the upper compartment, and various small drawers—and sometimes a cupboard—often with locks. In Britain around 1800, most of these convenient pieces of furniture were designed for use by women. This made the davenport desk somewhat unusual, though I expect in reality it was used by people of all ages and both genders. This type of desk would have been handy to take along for use in a ship's cabin or a tent during a military campaign.

By the mid 1800s, the davenport desk had evolved into the form that yours takes. Most had a set of small drawers down one side and a cupboard on the other. Wells to hold the ink bottles were placed either on top or in a small drawer as you describe, usually on the right-hand side. Most Victorian davenport desks date from the period 1850 to 1890, with walnut and mahogany most

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commonly used. There is a good typical example in the Royal Ontario Museum's European collection. Made in the Eastlake style, it is currently displayed in the Victorian section of the Samuel European Galleries.

Judging from the photographs, I agree that your davenport desk is likely to be oak, but some parts may also be ash, which has a similar grain and was often used in furniture towards 1900. The oak and supporting pillars, which are somewhat Gothic or Romanesque Revival, may have been used to give the desk a Medieval look. However, like many late Victorian pieces, your desk exhibits a variety of stylistic elements. The incised lines and scroll on the side of the compartment, and the gallery at the back composed of turned wooden balls and other small elements, suggest a date in the 1880s or even the early 1890s. I don't know whether there is any evidence of the original finish, but blonde varnished oak was usual at the time, and occasionally a dark varnish was used to give furniture a more antique appearance.

If you carefully check the wood surface, you may be able to discern the outline of the original drawer pulls. Based on the hardware I have seen from this period, they were likely oblong bail handles with a thick wire bar that conformed to the shape of the hand. The handles would have dropped down in front and been supported by rods mounted on screws at either end. The backplates, made of brass or possibly iron and likely oblong in shape, probably bore fine impressed geometric or floral designs or perhaps consisted of two flat bars that joined together at either end. You may be able to find appropriate replacement pulls at a good reproduction hardware store. A number of the Victorian designs are being reproduced.

As to the desk's use, the antique show dealer was correct. Small, more or less built-in desks of this form were commonly used in houses of parliament. Next time you watch the federal Parliament meeting in Ottawa, take a look at the MPs' desks. One of similar form said to be from the pre-1900 Ontario Parliament Buildings was offered to the Museum as a gift several years ago. Although an interesting piece, our curators declined to take it because it was in poor condition. I have even seen this type of desk used as a prop in studio portrait photographs from the 19th century. A dealer once told me that these desks were used on steamboats.

Although your desk lacks its original finish and hardware, it appears to be a rather nice example. If the locks in the drawers, the hinges, and the castors are of good calibre, it indicates a better-quality piece. I can't say whether it was made in Canada, the U.S.A., or Britain, although I suspect it could be North American. The wood is not really a determining factor because considerable timber was shipped from North America to England for various uses.

One line of inquiry you might pursue to confirm its origins is Toronto

WE'D LIKE TO HEAR FROM YOU

If you own furniture, silver, glass, metalwork, ceramics, textiles, or small decorative objects that may have an interesting past and have aroused your curiosity, this column is for you. Send a clear colour photograph (or 35-mm colour slide) of the object against a simple background, providing dimensions, a description, any markings, or any known details of its history to: ROM Answers, c/o *Rotunda* Magazine, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6. Be sure to enclose a stamped, self-addressed envelope large enough to include any photos that must be returned to you.

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Letters will be acknowledged as staff time permits.

architecture. The basis of English furniture was joinery, which was used for house building and panelling as well as interior woodwork. I have never before seen a davenport desk that used so many components borrowed from architecture and interior woodwork as yours does. For example, the bracket supporting the top resembles the brackets used to support the roof overhang at the edge of late Victorian roofs. The pillars resemble those used in Gothic and Romanesque Revival woodwork such as survives in the original round library at the Houses of Parliament in Ottawa. The gallery looks similar to panels of screening used on wooden verandahs and porches or as part of ornamental divider panels mounted on the arches that joined rooms in the late Victorian period. All of the component parts that I am describing are found in the period c. 1850–1900 in Canadian interiors and buildings such as University College, Toronto, and various churches.

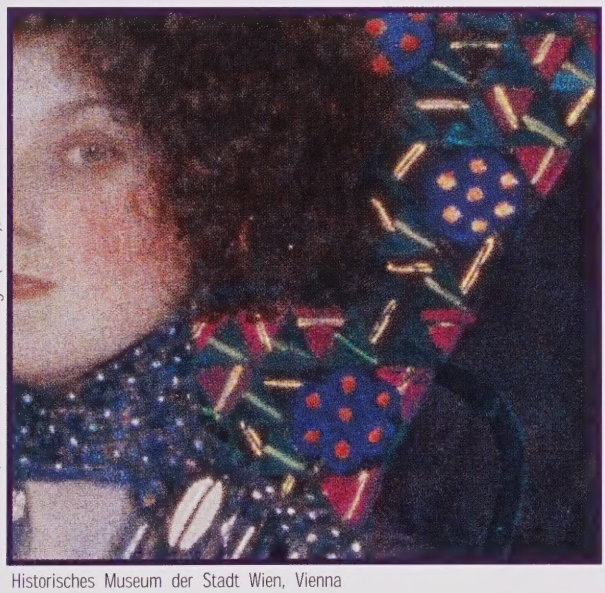
BRIAN BOYLE, ROM / 972.219

This davenport desk from ROM's collection is of walnut with panels of figured walnut made in Canada or the U.S.A. c.1865–1885. Gift of Mr. J. M. Laing.

The workshops that supplied these component parts often made them all from the same templates and to the same size and even in the same woods. You may be able to confirm a Canadian origin for your desk by doing some checking. Photograph and measure the distinctive wood components of your desk: the pillars, the brackets supporting the top, the carved leaf scroll at the base of the pillars, the turned gallery components at the back, even the turned drawer knob. A Toronto/Canadian origin is not impossible for your desk since it was bought here in 1951, well before major container loads of furniture began arriving from Britain and Europe.

Thank you for sharing your heirloom with our readers.

Peter Kaellgren is curator in the ROM's Department of Western Art and Culture, specializing in British and European decorative arts from 1500 onwards.



Gustav Klimt, *Portrait of Emilie Flöge* (detail), 1902

Historisches Museum der Stadt Wien, Vienna

GUSTAV KLIMT

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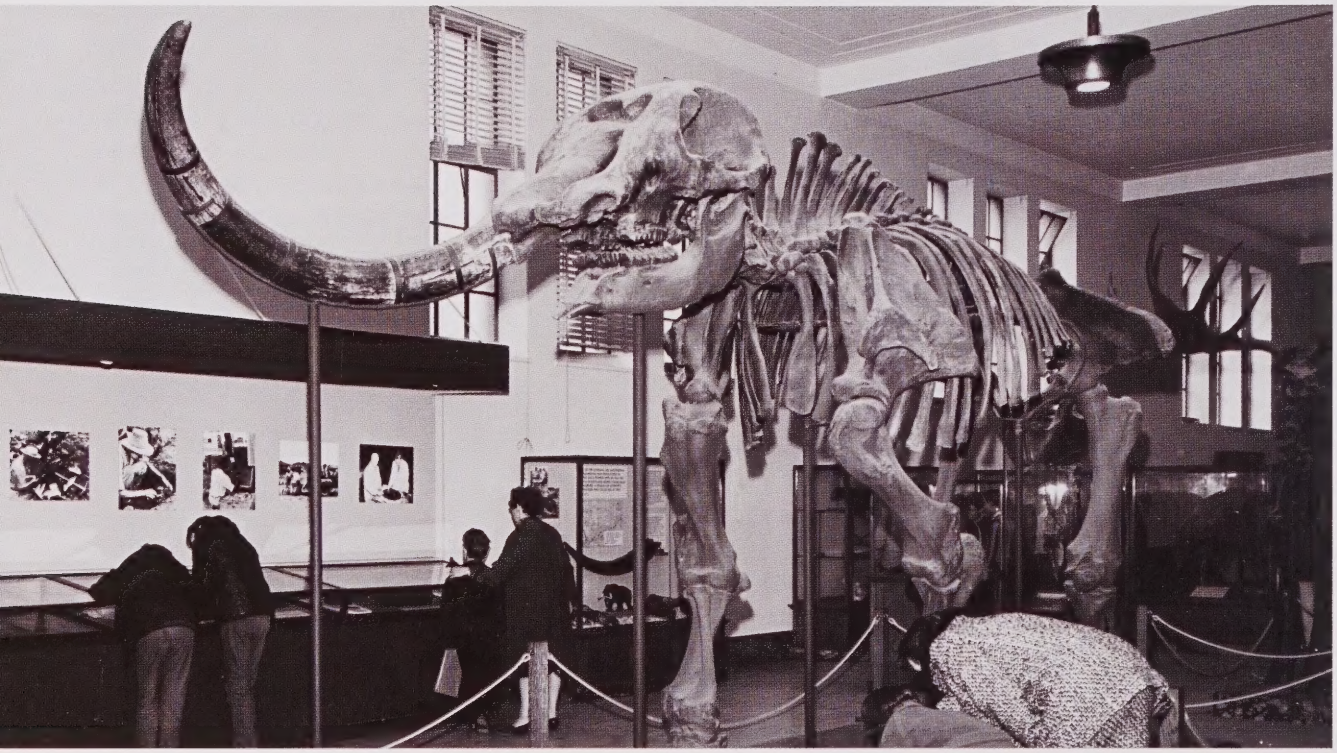
PLEISTOCENE GIANT

One-tusked mastodon looms large in ROM memory.



ROM ARCHIVES

THE ROM'S MASTODON—*Mammut americanum*—was unearthed in Welland County in 1912. This photograph captured the much-admired Ice-Age mammal specimen before it was moved to new quarters in the Vertebrate Fossil and Dinosaur galleries, which opened on the Museum's second floor in 1969. You can still find it there today among some of its Pleistocene neighbours, including the Irish Elk whose antlers are also visible in this photo. We didn't make label-reading easy in those days, but vigilant visitors discovered that this mastodon probably had only one tusk for most of its life—the tusk socket where the other would have been is deformed.

Visible in the background are venetian blinds—which then served as part of the ROM's high-tech climate control system—fieldwork photos on the wall, and graceful stanchions fashioned by ROM carpenters.

JULIA MATTHEWS

Julia Matthews has been head of the ROM's Library and Archives since 1983.

If you remember an occasion at the ROM or an exhibition that has stayed with you across the years, send us your reminiscences at info@rom.on.ca.

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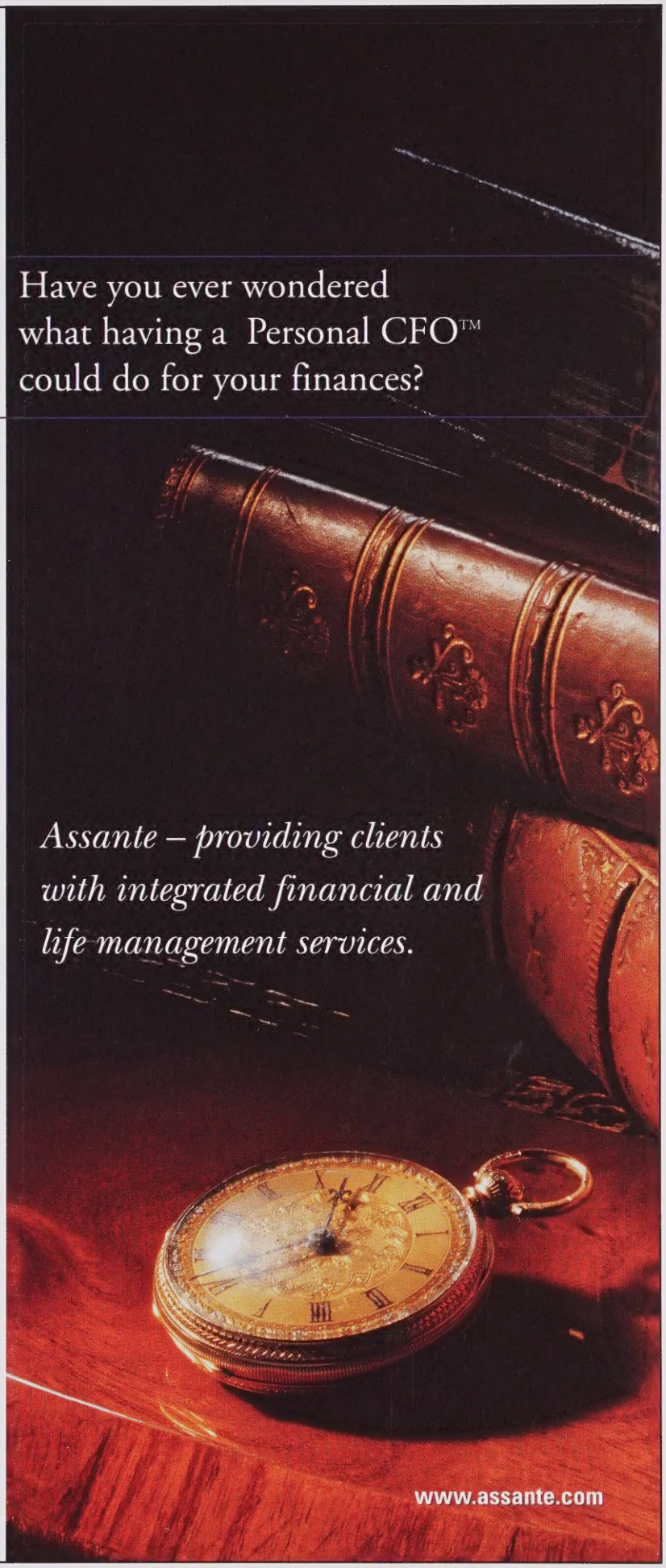
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